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US ARMY INSTITUTE OF DENTAL RESEARCH ANNUAL PROGRESS REPORT FY8-ETC(U)  
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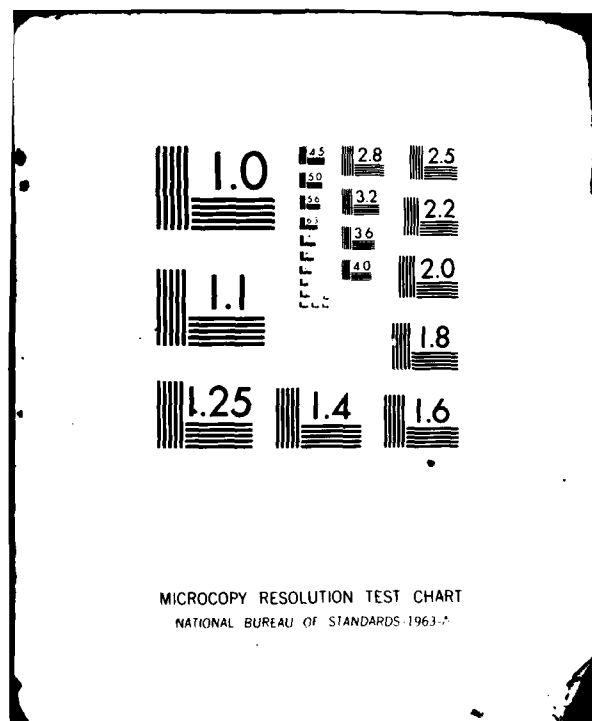
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# U.S. ARMY INSTITUTE OF DENTAL RESEARCH

## ANNUAL PROGRESS REPORT FY 1980

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1 October 1980

UNITED STATES ARMY INSTITUTE OF DENTAL RESEARCH  
WALTER REED ARMY MEDICAL CENTER  
WASHINGTON, D.C., 20012

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US ARMY INSTITUTE OF DENTAL RESEARCH  
WALTER REED ARMY MEDICAL CENTER  
Washington, D.C. 20012

US ARMY INSTITUTE OF DENTAL RESEARCH  
ANNUAL PROGRESS REPORT  
1 Oct 1979 - 30 Sep 1980

DA Project	3A161101A91C	Task 00	<u>In-House Laboratory Independent Research</u>
DA Project	3S161102BS06	Task 04	<u>Research in Biomedical Sciences - Dentistry</u>
DA Project	3S162775A825	Task 00	<u>Combat Maxillofacial Injury</u>

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER MEDDH-288-R1	2. GOVT ACCESSION NO. AD-A111 730	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) US Army Institute of Dental Research Annual Progress Report FY 80		5. TYPE OF REPORT & PERIOD COVERED Annual 1 Oct 79 - 30 Sep 80
7. AUTHOR(s) Thomas P. Sweeney, COL, DC		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Institute of Dental Research Washington, DC 20012		8. CONTRACT OR GRANT NUMBER(s)
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Medical Research & Development Command HQDA (SGRD-RMS) Ft Detrick, MD 21701		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 3A161101A91C Task 00 3S161102BS06 Task 04 3S162775A825 Task 00
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		12. REPORT DATE 1 October 1980
		13. NUMBER OF PAGES 76
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16. DISTRIBUTION STATEMENT (of this Report)  Approved for Public Release: Distribution Unlimited		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES  None		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Adhesive Composite; Airborne Carcinogens; Anaerobic Wound Infection; Anaerobic Bacteroidaceae; Base Metal Casting; Base Metal Restoration; Biodegradable Composite; Biodegradable Copolymers; Biodegradable PLA-PGA; Biodegradable Splint; Bone Injury; Bone Powder; Bone Resorption; Carbon Dioxide Laser; Carbon Dioxide Snow; Casting Accuracy; Cement Kiln Dust; Ceramic Powder; Ceramigold II; (cont)		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) DA Project 3A161101A91C In-House Laboratory Independent Research-This program is instituted as one aspect of a broad approach to provide individual Army Scientists and Engineers an additional opportunity to maintain and increase their competence by doing original work in areas suiting their talents, thereby promoting a vigorous internal research program of the highest technical caliber. Task 00  (cont. on reverse)		

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EDITION OF 1 NOV 65 IS OBSOLETE

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19. Chlorhexidene; Cidex; Climactic Conditions; Climate Extremes; Combat Wounds; Craniofacial Defects; Denture Cleansing; Dental Devices; Dental Disease Prevention; Diagnosis in Saliva; Diagnosis of Pulp Vitality; Doppler System; Electrical Stimulation; Endodontic Irrigation; Epidermal Growth Factor; Esophageal Graft; Field Dental Units; Gingival Healing; Gingivitis; Granular Ceramic Implant; Gutta Percha; High-Temp; Inhibition of Bone Resorption; Inorganic Nickel; Investment Material; Isoelectric Focusing; Laser Welding; Lip Ointment; Lip Pathology; Low-Gold Alloys; Malposed Incisors; Materials Storage; Mercury Intoxication; Methyl Methacrylate Toxicity; Microencapsulation; Microporous Filters; Monomer of Methyl Methacrylate; Neodymium Laser; Nerve Gas; Ni-Be Free Alloy; Nickel-Based Alloy; Nitinol; Oral Health; Osteoclast Activating Factor; Osteogenesis; Osteogenic Agents; Palatal Wound Healing; Particulate Pollutants; Pathogenic Organism Identification; Periodontal Defects; Periodontal Surgery; Polyglycolic Acid; Polylactic Acid; Prostaglandin; Prosthesis Repair; Protein Profiles; Pulpal Sound; Pulpal Vitality; Restorative Materials; Root-Canal Filling; Saliva: Salivary Electrolytes; Salivary Protein; Serum Lipids; Serum Proteins; Shape Memory; Silver-Laden Alloys; Sonacide; Spoon-toothbrush; Sporocidin; Storage Simulation; Tetracycline; Thermal Pulp Testing; Trace Elements; Tracheal Graft; Tricalcium Phosphate; Tricalcium Phosphate Ceramic; Water Contamination; Water Purification; Wound Healing.

(Continuation of Block 20)

DA Project 3S161102BS06/ Combat Dental Materials and Techniques-The objectives are to obtain information by the techniques of clinical and basic research on injuries and diseases, except communicable diseases, commonly seen in soldiers; especially in field operations and overseas. The work is divided according to the major medical specialties. Emphasis is placed on diseases and injuries which are receiving little or no study by civilian research groups, and the work is aimed at providing better preventive measures as well as treatment.

Task 04

Division of Oral Biology

DA Project 3S162775A825 Combat Maxillofacial Injury.-The objectives are to develop simplified procedures for the care of complex maxillofacial wounds and injuries which require long time-consuming procedures for reconstruction, to achieve minimal morbidity rates from oral emergencies, preventable oral disease, and restorative failures. To develop more efficient, simplified, effective clinical and laboratory techniques which will result in better utilization of manpower and a saving in time and materiel.

Task 00

Division of Oral Pathology

Division of Dental Materials

Division of Clinical Operations

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## FOREWORD

During FY 80 the US Army Institute of Dental Research has continued to emphasize and make progress in the development of new and innovative approaches to the diagnosis and management of combat maxillofacial injuries. Significant progress also continues in areas of broader application to the medical support of the combat soldier. Included are advances in chemical defense, drug therapy and surgical methodology.

Cooperative efforts with Medical Research and Development Command (MRDC) laboratories and other government agency laboratories continue to provide an expanded capability for our in-house efforts. The cooperative efforts include an investigation with the US Army Biomedical Laboratory (BML) on the use of saliva in the diagnosis of CW agent intoxication, a study of the effects of high-velocity missiles on maxillofacial wound morphology with the Edgewood Arsenal, a study with the Food and Drug Administration (FDA) on the quality of local anesthetics used by the Army Dentist, field studies with the Health Services Command (HSC) on a spoon-toothbrush for field use and lip-protection medicaments for use in extreme environments and finally a grant from the National Institute of Dental Research for basic studies on bone resorption.

The loss of qualified scientific personnel has been and continues to be a significant problem. In spite of these losses progress has continued. Among the more promising accomplishments are the following:

1. The morphology of high-velocity missile wounds of the maxillofacial area have been determined and the need for reassessment of the methods and materials for managing maxillofacial combat wounds has been demonstrated.

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2. Microencapsulated extended-release antibiotics have been successfully tested in experimental animals and show great promise as a significant means of drug therapy in the field.

3. A partly biodegradable mandibular fixation device has been constructed which will hold osteogenic agents in place at the bone repair site.

4. A powerful bone resorption inhibitor has been detected in bony explant cultures which could have considerable significance in the ultimate control of bone resorption during the healing of maxillofacial wounds.

5. Experimental animals with biodegradable esophageal repair devices have been returned to full function and are currently functioning as long as two years post-operatively.

6. The osteoclast activating factor which plays a central role in bone resorption has been further characterized.

7. Data obtained to date indicate that it may be possible to diagnose and identify nerve agent intoxicants in saliva.

8. A number of dental materials have been evaluated for their acceptability for Army use.

9. A method has been developed for controlling microbial contamination of the water supply of field dental units.



USAIDR PROJECTS, TASKS, AND WORK UNITS

(Responsible Division in Parentheses)

3A161101A91C	IN-HOUSE LABORATORY INDEPENDENT RESEARCH	<u>Page No.</u>
00	In-House Laboratory Independent Research	
DA OG 6043	A Rapid Water Purification System for Field Dental Units (Oral Biology)	1
DA OG 6045	Development of Techniques for the Determination of the Concentration of Inorganic Nickel and Other Particulate Pollutants in Army Dental Laboratories (Dental Materials)	2
DA OG 6047	Storage Stability of Materials of Interest to the Military Dentist (Dental Materials)	3
DA OG 6048	Induced Osteogenesis in Craniofacial Defects Using a Biodegradable Ceramic Augmented with Freeze-Dried Species Specific Bone Powder (Pathology)	4
DA OG 6049	The Effect of Epidermal Growth Factor on Palatal Wound Healing (Pathology)	5
DA OH 6035	An Investigation Into the Suspected Modulating Effect of Tricalcium Phosphate on Bone Resorption <i>In Vitro</i> (Oral Biology)	6
DA OH 6040	Pulpal Sound as a Diagnostic Test of Pulp Vitality (Clinical Operations)	7
DA OH 6041	Changes in Serum Protein and Lipid Composition as a Result of Exposure to Methyl Methacrylate Monomer (Oral Biology)	8
DA OH 6042	Evaluation of Protein Profiles Obtained by Electrophoretic Methods for the Rapid Identification of Pathogenic Organisms Associated with Combat Wounds (Oral Biology)	9
DA OH 6043	The Effect of Cement Kiln Dust on Wound Healing in Experimental Animals (Oral Biology)	10

3S161102BS06	RESEARCH IN BIOMEDICAL SCIENCES	
04	Dentistry	Page No.
DA OB 6037	Acceleration of Wound Healing (Oral Biology)	11
DA OD 6021	Problems Involved in Military Oral Health Care Delivery Related to Therapeutic Agents and Materials (Oral Biology)	12
DA OF 6024	Identification and Control of Orofacial Infections of Military Importance (Oral Biology)	13
DA OG 0717	Study of Saliva as a Diagnostic Tool for Presence of Lethal Agents (Oral Biology)	14
3S162775A825	ORAL AND MAXILLOFACIAL SCIENCES	
00	Oral and Maxillofacial Sciences	
DA OD 6048	Development and Evaluation of Nitinol for Use in Dentistry (Dental Materials)	15
DA OE 6022	Preventive Dentistry Measures of Military Significance (Pathology)	16
DA OF 6040	Application of Laser Technology to Maxillo- facial Wound Debridement and Prosthetic Rehabilitation (Pathology)	17
DA OG 6033	Development and Evaluation of Dental Materials and Materiel for Army Use (Dental Materials)	18
DA OG 6034	Development and Improvement of Metallic Restorative Materials (Dental Materials)	19
DA OH 6030	Natural History of Oral Lesions Encountered in the Soldier (Pathology)	20
DA OH 6037	New and Improved Techniques for Grafts and Bone Regeneration in Traumatic Wounds (Pathology)	21
DA OH 6038	Development of Endodontic Procedures for Military Dentistry (Oral Biology)	22
DA OK 6020	Biodegradable Materials for the Treatment of Fractures and Soft Tissue Wounds in the Military Situation (Pathology)	23

RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY				1. AGENCY ACCESSION <sup>a</sup>	2. DATE OF SUMMARY <sup>b</sup>	REPORT CONTROL SYMBOL DD-DR&E(AR)636	
3. DATE PREV SUMMARY	4. KIND OF SUMMARY	5. SUMMARY SCTY <sup>c</sup>	6. WORK SECURITY <sup>d</sup>	7. REGRADING <sup>e</sup>	8. DSSN INSTR <sup>f</sup>	9. SPECIFIC DATA: CONTRACTOR ACCESS <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	
791001	K. COMP	U	U	NA	NL	A. WORK UNIT	
10. NO./CODES <sup>g</sup>	PROGRAM ELEMENT	PROJECT NUMBER	TASK AREA NUMBER	WORK UNIT NUMBER			
a. PRIMARY	61101A	3A161101A91C	00	368			
b. CONTRIBUTING							
c. CONTRIBUTING							
11. TITLE (Precede with Security Classification Code) <sup>h</sup>							
A Rapid Water Purification System for Field Dental Units							
12. SCIENTIFIC AND TECHNOLOGICAL AREAS <sup>i</sup>							
002400 Bioengineering							
13. START DATE		14. ESTIMATED COMPLETION DATE		15. FUNDING AGENCY		16. PERFORMANCE METHOD	
78 06		79 06		DA		C. In House	
17. CONTRACT/GRANT				18. RESOURCES ESTIMATE		19. PROFESSIONAL MAN YRS	
a. DATES/EFFECTIVE: N/A				PRECEDING		b. FUNDS (In thousands)	
b. NUMBER:				FISCAL YEAR		c. FUNDS (In thousands)	
c. TYPE				80		0.5	
d. KIND OF AWARD:				CURRENT		3.0	
e. AMOUNT:				81		NA	
f. CUM. AMT.				NA		NA	
19. RESPONSIBLE DOD ORGANIZATION				20. PERFORMING ORGANIZATION			
NAME: U. S. Army Institute of Dental Research				NAME: U. S. Army Institute of Dental Research			
ADDRESS: Washington, DC 20012				ADDRESS: Division of Oral Biology Washington, DC 20012			
RESPONSIBLE INDIVIDUAL				PRINCIPAL INVESTIGATOR (Furnish SSAN if U.S. Academic Institution)			
NAME: COL Thomas P. Sweeney, DC				NAME: COL Charles E. Hawley, DC			
TELEPHONE: 202 - 576-3484				TELEPHONE: 202 - 576-3764			
21. GENERAL USE				SOCIAL SECURITY ACCOUNT NUMBER:			
Foreign Intelligence Considered				ASSOCIATE INVESTIGATORS			
				NAME:			
				NAME:			
22. KEYWORDS (Precede EACH with Security Classification Code) (U) Water Purification; (U) Field Dental Units; (U) Water Contamination; (U) Microporous Filters							
23. TECHNICAL OBJECTIVE <sup>j</sup> 24. APPROACH, 25. PROGRESS (Furnish individual paragraphs identified by number. Precede text of each with Security Classification Code.)							
23. (U) To modify the Field Dental Treatment and Operating Unit with a simple filtration system which will render its internal water circulating system free of known microbiological warfare agents and radiobiological debris with particle size greater than 0.2 $\mu$ m.							
24. (U) Various primary and secondary filters of various pore sizes will be inserted into the waterline connecting the unit water reservoir and unit console. Varying filter configurations will be tested for their ability to remove microbiologic and radiologic contaminants.							
25. (U) (7910-8010) Because of the reported limitations in the efficiency of unit decontamination imposed by our filtration systems, we investigated the possibility of chemical decontamination as a viable alternative to filters. Field dental units were filled with either communal tap water ( $4 \times 10^2$ bacteria/ml) or sterile water inoculated with <i>Pseudomonas aeruginosa</i> ( $6 \times 10^2$ bacteria/ml). Bacterial counts taken at the handpiece or water syringe showed $2 \times 10^6$ bacteria/ml. The potential for these high levels of bacterial contamination is believed to exist in all portable field dental units. Hydrogen peroxide, although not equally effective for all oral microorganisms, has been shown to be a practical method for the elimination of bacteria which colonize the water in dental equipment. Our data indicate that 3% hydrogen peroxide in water (1:100 ratio) effectively prevents the bacterial contamination of portable field dental units. This procedure may be recommended as a safe method for the delivery of bacteria-free water during dental treatment.							

<sup>a</sup> Available to contractors upon originator's approval.

DD FORM 1498  
1 MAR 68

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RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY				1. AGENCY ACCESSION <sup>a</sup>	2. DATE OF SUMMARY <sup>a</sup>	REPORT CONTROL SYMBOL DD DR&E(AR)636	
3. DATE PREV SUMMARY <sup>a</sup>	4. KIND OF SUMMARY	5. SUMMARY SCTY <sup>a</sup>	6. WORK SECURITY <sup>a</sup>	7. REGRADING <sup>a</sup>	8. DISSEM INSTR <sup>a</sup>	9. SPECIFIC DATA - CONTRACTOR ACCESS <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	
791001	K. COMP	U	U	N/A	NL	A. WORK UNIT	
10. NO./CODES <sup>a</sup>	PROGRAM ELEMENT	PROJECT NUMBER	TASK AREA NUMBER	WORK UNIT NUMBER			
A. PRIMARY	61101A	34161101A916	00	370			
B. CONTRIBUTING							
C. CONTRIBUTING							
11. TITLE (Precede with Security Classification Code) <sup>a</sup> Development of Techniques for the Determination of the Concentration of Inorganic Nickel and Other Particulate Pollutants in Army Dental Laboratories.							
12. SCIENTIFIC AND TECHNOLOGICAL AREAS <sup>a</sup> 03100 Miscellaneous Materials							
13. START DATE		14. ESTIMATED COMPLETION DATE		15. FUNDING AGENCY		16. PERFORMANCE METHOD	
7806		7906		DA		C. In House	
17. CONTRACT/GRANT				18. RESOURCES ESTIMATE		19. PROFESSIONAL MAN YRS	
A. DATES/EFFECTIVE: N/A				PRECEDING		B. FUNDS (In thousands)	
B. NUMBER:				FISCAL YEAR		C. CURRENT	
C. TYPE:				80		0.3	
D. AMOUNT:				81		NA	
E. CUM. AMT.				NA		NA	
19. RESPONSIBLE DOD ORGANIZATION				20. PERFORMING ORGANIZATION			
NAME: U. S. Army Institute of Dental Research				NAME: U. S. Army Institute of Dental Research			
ADDRESS: Washington, DC 20012				ADDRESS: Division of Dental Material Washington, DC 20012			
RESPONSIBLE INDIVIDUAL				PRINCIPAL INVESTIGATOR (Pursuant to 38 USC 552(a)(7)(D))			
NAME: COL Thomas P. Sweeney, DC				NAME: COL E. F. Huget, DC			
TELEPHONE: 202 - 576-3484				TELEPHONE: 202 - 576-3092			
21. GENERAL USE				SOCIAL SECURITY ACCOUNT NUMBER:			
Foreign Intelligence Considered				ASSOCIATE INVESTIGATORS			
				NAME: LTC S. G. Vermilyea, DC			
				NAME:			
22. KEYWORDS (Precede EACH with Security Classification Code) (U) Inorganic Nickel; (U) Particulate Pollutants; (U) Airborne Carcinogens							
23. TECHNICAL OBJECTIVE, 24. APPROACH, 25. PROGRESS (Pursuant to 38 USC 552(a)(7)(D))							
23. (U) To establish within USAIDR the capability to monitor and to measure the concentration of nickel and other particulate pollutants in Army Dental Laboratories.							
24. (U) Airborne particulate matter will be collected from a metal-finishing room for a period of 35 days. Dust acquired from five intramural locations will be analyzed quantitatively for nickel content.							
25. (U) (7910-8010) Particulate matter was collected monthly over a period of 12 months from the metal-finishing room of an Army production dental laboratory, using an automatic sampling device. Analyses of the collected samples by atomic absorption spectrophotometry revealed the presence of nickel and copper in concentrations well within safe limits for those metals (published TLV values). Determinations made on the same samples for beryllium and chromium were negative. The results indicate that the collection and analysis technique provide a simple and extremely sensitive means of monitoring the presence of potentially toxic levels of airborne metal dust in an Army dental laboratory metal-finishing room.							

<sup>a</sup> Available to contractors upon contractor's approval.

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1 MAR 68

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RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY				1. AGENCY ACCESSION <sup>a</sup>	2. DATE OF SUMMARY <sup>a</sup>	REPORT CONTROL SYMBOL DD-DR&E(AR)636	
3. DATE PREV SUMRY	4. KIND OF SUMMARY	5. SUMMARY SCTY <sup>a</sup>	6. WORK SECURITY <sup>a</sup>	7. REGRADING <sup>a</sup>	8A. DMSN INSTR <sup>a</sup>	8B. SPECIFIC DATA - CONTRACTOR ACCESS	9. LEVEL OF SUM
79 10 01	D. CHANGE	U	U	NA	NL	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	A. WORK UNIT
10. NO / CODES: <sup>a</sup>	PROGRAM ELEMENT	PROJECT NUMBER		TASK AREA NUMBER		WORK UNIT NUMBER	
A. PRIMARY	61101A	3A161101A91C		00		372	
B. CONTRIBUTING							
C. CONTRIBUTING							
11. TITLE (Precede with Security Classification Code) <sup>a</sup>							
(U) Storage Stability of Materials of Interest to the Military Dentist.							
12. SCIENTIFIC AND TECHNOLOGICAL AREAS <sup>a</sup>							
03100 Miscellaneous Materials							
13. START DATE		14. ESTIMATED COMPLETION DATE		15. FUNDING AGENCY		16. PERFORMANCE METHOD	
79 07		80 07		DA		C. IN HOUSE	
17. CONTRACT/GRANT				18. RESOURCES ESTIMATE		19. PROFESSIONAL MAN YRS	
A. DATES/EFFECTIVE:				PRECEDING		B. FUNDS (In thousands)	
B. NUMBER: <sup>a</sup> NA				FISCAL YEAR		80 0.2 5.0	
C. TYPE:				CURRENT		81 0.2 5.0	
D. KIND OF AWARD:				F. CUM. AMT.			
19. RESPONSIBLE DOD ORGANIZATION				20. PERFORMING ORGANIZATION			
NAME: <sup>a</sup> US Army Institute of Dental Research				NAME: <sup>a</sup> US Army Institute of Dental Research			
ADDRESS: <sup>a</sup> Washington, D.C. 20012				ADDRESS: <sup>a</sup> Washington, D.C. 20012			
RESPONSIBLE INDIVIDUAL				PRINCIPAL INVESTIGATOR (Furnish SSAN if U.S. Academic Institution)			
NAME: SWEENEY, THOMAS P., COL, DC				NAME: <sup>a</sup> HUGET, E.F., COL, DC			
TELEPHONE: 202-576-3484				TELEPHONE: 202-576-3092			
21. GENERAL USE				SOCIAL SECURITY ACCOUNT NUMBER:			
Foreign Intelligence Considered				ASSOCIATE INVESTIGATORS			
				NAME: VERMILYEA, S.G., DC, LTC			
				NAME: FEHRMAN, S.G., 1LT, MSC			
22. KEYWORDS (Precede EACH with Security Classification Code)							
(U)Materials Storage(U)Restorative Materials(U)Climactic Conditions(U)Storage Simulation							
23. TECHNICAL OBJECTIVE, <sup>a</sup> 24. APPROACH, 25. PROGRESS (Furnish individual paragraphs identified by number. Precede text of each with Security Classification Code.)							
<p>23. (U) Among the most prominent problems in providing logistical support to the military dentist world wide are those related to the shipment and storage of certain dental materials. Climactic conditions ranging through tropical, arid and artic-like can have a profound effect on the properties and characteristics of such substances as organic-inorganic composites, waxes and elastomeric impression materials. The objective of this study is to develop reliable techniques for the assessment of the storage stability of a variety of dental materials so that the most suitable materials for application in the field environment can be identified.</p> <p>24. (U) A programmable, extended range, constant temperature/humidity cabinet will be used to evaluate the "Weatherability" of dental composite restoratives. Unopened "as-received" packages of selected materials will be subjected to simulated storage conditions ranging from 10 to 90 days followed by conventional testing to determine the effects of those conditions on the properties and characteristics of the subject materials.</p> <p>25. (U) (79 10 - 80 10) Work on this task has not yet begun. The programmable extended range constant temperature/humidity cabinet required for this study has not yet been received from the manufacturer. Studies will be initiated immediately upon installation.</p>							

MILITARY RELEVANCY CERTIFIED UNDER  
SECTION 204 (FY 1980 FUNDS)  
BY: *Bernard G. Sweeney*

DD FORM 1498  
1 MAR 68

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AND 1498-1, 1 MAR 68 (FOR ARMY USE) ARE OBSOLETE.

RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY				1. AGENCY ACCESSION <sup>a</sup>	2. DATE OF SUMMARY <sup>a</sup>	REPORT CONTROL SYMBOL DD-DR&E(AK)636	
3. DATE PREV. SUMMARY	4. KIND OF SUMMARY	5. SUMMARY SCTY <sup>a</sup>	6. WORK SECURITY <sup>a</sup>	7. REGRADING <sup>a</sup>	8A. DDB'S INSTR <sup>a</sup>	8B. SPECIFIC DATA - CONTRACTOR ACCESS	9. LEVEL OF SUM
791001	H. TERM	U	U	NA	NL	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	A. WORK UNIT
10. NO. CODES <sup>a</sup>	PROGRAM ELEMENT	PROJECT NUMBER	TASK AREA NUMBER	WORK UNIT NUMBER			
A. PRIMARY	61101A	3A161101A91C	00	373			
B. CONTRIBUTING							
C. CONTRIBUTING							
11. TITLE (Precede with Security Classification Code) <sup>a</sup> (U) Induced Osteogenesis in Craniofacial Defects Using a Biodegradable Ceramic Augmented with Freeze-Dried Species Specific Bone Powder.							
12. SCIENTIFIC AND TECHNOLOGICAL AREAS <sup>a</sup> 012900 Physiology							
13. START DATE		14. ESTIMATED COMPLETION DATE		15. FUNDING AGENCY		16. PERFORMANCE METHOD	
7905		8001		DA		C. In House	
17. CONTRACT GRANT				18. RESOURCES ESTIMATE		19. PROFESSIONAL MAN YRS	
A. DATES/EFFECTIVE: NA				PRECEDING		B. FUNDS (In thousands)	
B. NUMBER <sup>a</sup>				FISCAL YEAR		80	
C. TYPE				CURRENT		0.1	
D. KIND OF AWARD:				81		NA	
E. AMOUNT:				NA		NA	
F. CUM. AMT.				NA		NA	
19. RESPONSIBLE DOD ORGANIZATION				20. PERFORMING ORGANIZATION			
NAME <sup>a</sup> U. S. Army Institute of Dental Research				NAME <sup>a</sup> U. S. Army Institute of Dental Research			
ADDRESS <sup>a</sup> Washington, DC 20012				ADDRESS <sup>a</sup> Division of Pathology Washington, DC 20012			
RESPONSIBLE INDIVIDUAL				PRINCIPAL INVESTIGATOR (Furnish SSAN if U.S. Academic Institution)			
NAME: COL Thomas P. Sweeney, DC				NAME <sup>a</sup> COL J. F. Nelson, DC			
TELEPHONE: 202 - 576-3484				TELEPHONE: 202 - 576-3080			
21. GENERAL USE				SOCIAL SECURITY ACCOUNT NUMBER:			
Foreign Intelligence Considered				ASSOCIATE INVESTIGATORS			
				NAME: COL W. R. Posey, DC			
				NAME:			
22. KEYWORDS (Precede EACH with Security Classification Code) (U) Osteogenesis; (U) Craniofacial Defects; (U) Biodegradable Ceramic; (U) Bone Powder							
23. TECHNICAL OBJECTIVE, <sup>a</sup> 24. APPROACH, 25. PROGRESS (Furnish individual paragraphs identified by number. Precede text of each with Security Classification Code.)							
<p>23. (U) Avulsive wounds of the maxillofacial complex and cranial areas have long posed a problem in effective resolution. Autogenous bone grafts have been found to be more successful than bone substitutes but require a second procedure which complicates the process and increases patient morbidity. The purpose of the present study is to determine the effect of combining powdered homograft freeze-dried bone with powdered biodegradable ceramic on osteogenesis in a created defect in the rat calvaria.</p> <p>24. (U) Created defects in rat calvaria will be filled with either a powdered tricalcium phosphate ceramic, powdered freeze-dried bone from the same species of rat used in the experiment, or a 50-50 combination of ceramic and bone powders. Controls will receive no filler material. Osteogenesis over a 16-week period will be studied histologically.</p> <p>25. (U) (7910-3010) The results of this study were negative. That is, there was no significant difference in the rate of healing between controls and the various experimental groups.</p>							

<sup>a</sup> Available to contractors upon originator's approval.

DD FORM 1498  
1 MAR 66

PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE. DD FORMS 1498A 1 NOV 65 AND 1498-1, 1 MAR 66 (FOR ARMY USE) ARE OBSOLETE.

RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY				1. AGENCY ACCESSION <sup>a</sup>	2. DATE OF SUMMARY <sup>a</sup>	REPORT CONTROL SYMBOL	
				OG 6049	801001	DD-DR&E(AR)636	
3. DATE PREV SUMPRY	4. KIND OF SUMMARY	5. SUMMARY SCTY <sup>a</sup>	6. WORK SECURITY <sup>a</sup>	7. REGRADING <sup>a</sup>	8a. DISEM INSTRN	8b. SPECIFIC DATA - CONTRACTOR ACCESS	9. LEVEL OF SUM
791001	D. CHANGE	U	U	NA	NL	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	A. WORK UNIT
10. NO. CODES <sup>a</sup>		PROGRAM ELEMENT	PROJECT NUMBER	TASK AREA NUMBER	WORK UNIT NUMBER		
a. PRIMARY		61101A	3A161101A91C	00	374		
b. CONTRIBUTING							
c. CONTRIBUTING							
11. TITLE (Precede with Security Classification Code) <sup>a</sup>							
(U) The Effect of Epidermal Growth Factor on Palatal Wound Healing							
12. SCIENTIFIC AND TECHNOLOGICAL AREAS <sup>a</sup>							
012900 Physiology							
13. START DATE		14. ESTIMATED COMPLETION DATE		15. FUNDING AGENCY		16. PERFORMANCE METHOD	
7905		8001		DA			
17. CONTRACT GRANT				18. RESOURCES ESTIMATE		19. PROFESSIONAL MAN YRS	
a. DATES/EFFECTIVE: N/A				PRECEDING		b. FUNDS (In thousands)	
d. NUMBER *				FISCAL YEAR		80	
c. TYPE				CURRENT		0.2	
e. KIND OF AWARD:				81		0.2	
f. CUM. AMT.						01	
19. RESPONSIBLE DOD ORGANIZATION				20. PERFORMING ORGANIZATION			
NAME * U. S. Army Institute of Dental Research				NAME * U. S. Army Institute of Dental Research			
ADDRESS * Washington, DC 20012				Division of Pathology			
				Washington, DC 20012			
RESPONSIBLE INDIVIDUAL				PRINCIPAL INVESTIGATOR (Furnish SSAN if U.S. Academic Institution)			
NAME: COL Thomas P. Sweeney, DC				NAME * COL W. M. Carpenter, DC			
TELEPHONE: 202 - 576-3484				TELEPHONE: 202 - 576-3778			
21. GENERAL USE				SOCIAL SECURITY ACCOUNT NUMBER:			
Foreign Intelligence Considered				ASSOCIATE INVESTIGATORS			
				NAME: COL J. F. Nelson, DC			
				NAME: Specialist Five S. Sidoff			
22. KEYWORDS (Precede EACH with Security Classification Code)							
(U) Epidermal Growth Factor; (U) Wound Healing; (U) Palatal Wound Healing							
23. TECHNICAL OBJECTIVE, 24. APPROACH, 25. PROGRESS (Furnish individual paragraphs identified by number. Precede text of each with Security Classification Code.)							
23. (U) The oral cavity is subject to trauma from a variety of sources. Healing of many oral tissue wounds requires epithelial growth. A protein termed "epidermal growth factor" (EGF) has been isolated from the submaxillary glands of rats and studied mostly <i>in vitro</i> . The objective of the present study is to determine the ability of EGF to accelerate the healing of palatal wounds in rats.							
24. (U) Control and experimental animals will receive palatal wounds by means to be determined. Experimental animals will be treated with EGF injections at the wound site at the time of wounding and twice daily until sacrifice. Controls will be similarly injected with physiological saline. Healing will be evaluated by a determination of the area of epithelial fill in the wounds, and histologic examination.							
25. (U) (7910-8010) Standardized wounds produced by CO <sub>2</sub> laser have been determined to be suitable for the purposes of this study. The floor of the mouth will be the injury site. Difficulties have been encountered in injecting the growth factor into the wound site without causing significant trauma. Cyanoacrylate tissue adhesives will be tested for the purpose of protecting the injection site. The study will continue when a final protocol has been established.							

DD FORM 1498

1 MAR 66

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MILITARY RELEVANCY CERTIFIED UNDER  
SECTION 204 (FY FUNDS)  
BY *[Signature]*

RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY				1. AGENCY ACCESSION <sup>a</sup>	2. DATE OF SUMMARY <sup>a</sup>	REPORT CONTROL SYMBOL DD-DR&E(AK)636	
3. DATE PREV SUMMARY	4. KIND OF SUMMARY	5. SUMMARY SCTY <sup>a</sup>	6. WORK SECURITY <sup>a</sup>	7. REGRADING <sup>a</sup>	8A. DDB'S INSTN <sup>a</sup>	8B. SPECIFIC DATA CONTRACTOR ACCESS	9. LEVEL OF SUB A. WORK UNIT
791001	K. COMP	U	U	NA	NL	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	
10. NO./CODES <sup>a</sup>	PROGRAM ELEMENT	PROJECT NUMBER	TASK AREA NUMBER	WORK UNIT NUMBER			
a. PRIMARY	61101A	3A161101A91C	00	375			
b. CONTRIBUTING							
c. CONTRIBUTING							
11. TITLE (Precede with Security Classification Code) <sup>a</sup> (U) An Investigation Into the Suspected Modulating Effect of Tricalcium Phosphate on Bone Resorption <i>In Vitro</i>							
12. SCIENTIFIC AND TECHNOLOGICAL AREAS <sup>a</sup> 012900 Physiology 002300 Biochemistry							
13. START DATE		14. ESTIMATED COMPLETION DATE		15. FUNDING AGENCY		16. PERFORMANCE METHOD	
79 05		79 12		DA		C. In House	
17. CONTRACT/GRANT				18. RESOURCES ESTIMATE		a. PROFESSIONAL MAN YRS	
a. DATES/EFFECTIVE: N/A				PRECEDING		b. FUNDS (in thousands)	
b. NUMBER <sup>a</sup>				FISCAL YEAR		80	
c. TYPE				CURRENT		0.3	
d. KIND OF AWARD:				81		NA	
e. AMOUNT:				NA		NA	
f. CUM. AMT.							
19. RESPONSIBLE DOD ORGANIZATION				20. PERFORMING ORGANIZATION			
NAME <sup>a</sup> U. S. Army Institute of Dental Research				NAME <sup>a</sup> U. S. Army Institute of Dental Research			
ADDRESS <sup>a</sup> Washington, DC 20012				Division of Oral Biology			
				ADDRESS <sup>a</sup> Washington, DC 20012			
RESPONSIBLE INDIVIDUAL COL Thomas P. Sweeney, DC				PRINCIPAL INVESTIGATOR (Furnish SSAN if U.S. Academic Institution)			
NAME:				NAME <sup>a</sup> COL Charles E. Hawley, DC			
TELEPHONE: 202 - 576-3484				TELEPHONE: 202 - 576-3764			
21. GENERAL USE				SOCIAL SECURITY ACCOUNT NUMBER:			
Foreign Intelligence Considered				ASSOCIATE INVESTIGATORS			
				NAME: COL A. J. SNYDER, DC			
				NAME:			
22. KEYWORDS (Precede EACH with Security Classification Code) (U) Tricalcium Phosphate Ceramic (U) Ceramic Powder (U) Bone Resorption (U) Inhibition of Bone Resorption							
23. TECHNICAL OBJECTIVE, 24. APPROACH, 25. PROGRESS (Furnish individual paragraphs identified by number. Precede text of each with Security Classification Code.)							
23. (U) Combat wounds of the maxillofacial area frequently involve the resorptive loss of osseous tissues. There is some evidence to indicate that phosphate produces an effect which is synergistic to the inhibitory effect of calcitonin on bone resorption. The objective of this study is to determine if tricalcium phosphate ceramic (TCP) which is used as a reparative modality in osseous tissues, also exerts a positive modulating effect on bone resorption <i>in vitro</i> .							
24. (U) An <i>in vitro</i> bioassay technique will be used to evaluate the effect of tricalcium phosphate ceramic on <sup>45</sup> Ca labeled fetal rat long bone cultures. Long bone explants will be cultured in the presence and absence of TCP and the quantitative release of <sup>45</sup> Ca will be used as an index of bone resorption.							
25. (U) (7910-8010) Using the <i>in vitro</i> bone resorption assay, we have shown that the biodegradable ceramic, TCP, in excess, will inhibit anticipated parathyroid hormone and osteoclast activating factor (OAF) stimulated release of calcium from bony explants. It has been further shown that the degree of OAF inhibition will consistently range from 32% to 47% (mean $\pm$ s.d. $38.5 \pm 5.03\%$ ). This inhibitory effect on physiologic and/or pathologic bone resorption may be the basis, in part, for the enhanced bony repair observed with tricalcium phosphate in clinical trials.							

<sup>a</sup> Available to contractors upon originator's approval.

DD FORM 1498

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RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY				1. AGENCY ACCESSION	2. DATE OF SUMMARY	REPORT CONTROL SYMBOL	
				OH 6040	80 10 01	DD-DR&E(AR)636	
3. DATE PREV. SUM'RY	4. KIND OF SUMMARY	5. SUMMARY SCTY	6. WORK SECURITY	7. REGRADING	8A. DISSEM INSTR	8B. SPECIFIC DATA - CONTRACTOR ACCESS	9. LEVEL OF SUM
79 10 01	H. TERM	U	U	NA	NL	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	A. WORK UNIT
10. NO. CODES*		PROGRAM ELEMENT	PROJECT NUMBER	TASK AREA NUMBER	WORK UNIT NUMBER		
A. PRIMARY		61101A	3A161101A91C	00	405		
B. CONTRIBUTING							
C. CONTRIBUTING							
11. TITLE (Precede with Security Classification Code)*							
(U) Pulpal Sound as a Diagnostic Test of Pulp Vitality							
12. SCIENTIFIC AND TECHNOLOGICAL AREAS*							
012900 Physiology 002400 Bioengineering							
13. START DATE		14. ESTIMATED COMPLETION DATE		15. FUNDING AGENCY		16. PERFORMANCE METHOD	
79 05		79 09		DA		C. IN HOUSE	
17. CONTRACT/GRANT				18. RESOURCES ESTIMATE		19. PROFESSIONAL MAN YRS	
A. DATES/EFFECTIVE:				PRECEDING		B. FUNDS (In thousands)	
D. NUMBER* NA				FISCAL YEAR		80	
C. TYPE				CURRENT		0.2	
E. KIND OF AWARD:				81		NA	
F. CUM. AMT.				NA		NA	
19. RESPONSIBLE DOD ORGANIZATION				20. PERFORMING ORGANIZATION			
NAME* US Army Institute of Dental Research				NAME* US Army Institute of Dental Research			
ADDRESS* Washington, D.C. 20012				Division of Clinical Operations			
				ADDRESS* Washington, D.C. 20012			
RESPONSIBLE INDIVIDUAL				PRINCIPAL INVESTIGATOR (Furnish SSAN if U.S. Academic Institution)			
NAME. SWEENEY, THOMAS P., COL, DC				NAME* Peters, D.D., COL, DC			
TELEPHONE. 202-576-3484				TELEPHONE: 301-677-7306			
21. GENERAL USE				SOCIAL SECURITY ACCOUNT NUMBER:			
				ASSOCIATE INVESTIGATORS			
				NAME: Lorton, L., LTC, DC			
				NAME:			
22. KEYWORDS (Precede EACH with Security Classification Code)							
(U) Pulp Vitality (U) Pulpal Sound (U) Diagnosis of Pulp Vitality (U) Doppler System							
23. TECHNICAL OBJECTIVE, 24. APPROACH, 25. PROGRESS (Furnish individual paragraphs identified by number. Precede text of each with security Classification Code.)							
<p>23. (U) Present tests of endodontic vitality are of limited value. All depend on nervous vitality which is a questionable approach. Nerve vitality is not essential to pulp vitality while blood flow is essential. Therefore the objective of this study is to determine if the sound of pulpal blood flow can be determined and used as an index of pulp vitality.</p> <p>24. (U) Two experimental listening devices will be tested; a surface transducer system which directly monitors acoustic vibration and an ultrasonic doppler system. The sound not responding to electric and cold pulp testers will receive "test preparations." Results from all methods will be correlated and cross tabulated.</p> <p>25. (U) (79 10 - 80 10) The results of this study to date have been negative and it is therefore terminated.</p>							

\* Available to contractors upon originator's approval

DD FORM 1498  
1 MAR 68

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RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY				1. AGENCY ACCESSION <sup>a</sup>	2. DATE OF SUMMARY <sup>a</sup>	REPORT CONTROL SYMBOL DD-DR&E(AR)636	
3. DATE PREV. SUMRY	4. KIND OF SUMMARY	5. SUMMARY SCTY <sup>a</sup>	6. WORK SECURITY <sup>a</sup>	7. REGRADING <sup>a</sup>	8. DES'N INSTR'N	9. SPECIFIC DATA - CONTRACTOR ACCESS <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	10. LEVEL OF SUM A. WORK UNIT
791001	K. COMP	U	U	NA	NL		
10. NO. CODES <sup>a</sup>		PROGRAM ELEMENT	PROJECT NUMBER	TASK AREA NUMBER	WORK UNIT NUMBER		
a. PRIMARY		61101A	3161101A91C	00	407		
b. CONTRIBUTING							
c. CONTRIBUTING							
11. TITLE (Precede with Security Classification Code) <sup>a</sup> (U) Evaluation of Protein Profiles Obtained by Electrophoretic Methods for the Rapid Identification of Pathogenic Organisms Associated with Combat Wounds							
12. SCIENTIFIC AND TECHNOLOGICAL AREAS <sup>a</sup> 010100 Microbiology 002300 Biochemistry							
13. START DATE		14. ESTIMATED COMPLETION DATE		15. FUNDING AGENCY		16. PERFORMANCE METHOD	
7905		8002		DA		C. In House	
17. CONTRACT, GRANT				18. RESOURCES ESTIMATE		19. PROFESSIONAL MAN YRS	
a. DATES/EFFECTIVE: NA EXPIRATION:				PRECEDING		b. FUNDS (in thousands)	
c. NUMBER *				FISCAL YEAR		80	
d. TYPE				CURRENT		0.5	
e. KIND OF AWARD:				81		NA	
f. CUM. AMT.				NA		NA	
19. RESPONSIBLE DOD ORGANIZATION				20. PERFORMING ORGANIZATION			
NAME * U. S. Army Institute of Dental Research				NAME * U. S. Army Institute of Dental Research			
ADDRESS * Washington, DC 20012				Division of Oral Biology			
				ADDRESS * Washington, DC 20012			
RESPONSIBLE INDIVIDUAL				PRINCIPAL INVESTIGATOR (Furnish SSAN if U.S. Academic Institution)			
NAME COL Thomas P. Sweeney, DC				NAME * Jean A. Setterstrom, Ph.D.			
TELEPHONE: 202 - 576-3484				TELEPHONE: 202 - 576-3662			
21. GENERAL USE				SOCIAL SECURITY ACCOUNT NUMBER:			
Foreign Intelligence Considered				ASSOCIATE INVESTIGATORS			
				NAME: MAJ Norman E. Bussell, DC			
				NAME:			
22. KEYWORDS (Precede EACH with Security Classification Code) (U) Pathogenic Organism Identification; (U) Protein Profiles; (U) Combat Wounds; (U) Isoelectric Focusing							
23. TECHNICAL OBJECTIVE, 24. APPROACH, 25. PROGRESS (Furnish individual paragraphs identified by number. Precede text of each with Security Classification Code.)							
23. (U) A suitable scheme for classification and identification of alpha and nonhemolytic streptococci which comprise a significant part of the flora of the oral cavity and upper respiratory tract is lacking. The purpose of this investigation is to determine in principle the application of protein profiles as a means of identifying the species and serotypes of streptococci.							
24. (U) Representative strains of oral streptococci will be disrupted by ultrasound and then treated enzymatically. Cell walls and cytoplasmic membranes will be separated by ultracentrifugation. The resulting preparations will be subjected to isoelectric focusing in polyacrylamide gel, SDS gel electrophoresis, and SDS density gradient gel electrophoresis. Profiles thus obtained will be studied for points of difference among the individual strains and species as a basis for positive identification.							
25. (U) (7910-8010) Protein profile studies of seven species of oral streptococci have been completed. Highly distinguishable species-specific protein bands have been identified for each species. The results have demonstrated that the approach used is chemotaxonomically useful in distinguishing the organisms studied and establishes the practicability of using the above electrophoretic methods as a rapid method for identifying pathogenic organisms associated with combat wounds.							

<sup>a</sup>Available to contractors upon originator's approval.

DD FORM 1498  
1 MAR 68

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RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY				1. AGENCY ACCESSION <sup>a</sup>	2. DATE OF SUMMARY <sup>a</sup>	REPORT CONTROL SYMBOL DD-DR&E(AR)636	
3. DATE PREV. SUMMARY	4. KIND OF SUMMARY	5. SUMMARY SCTY <sup>a</sup>	6. WORK SECURITY <sup>a</sup>	7. REGRADING <sup>a</sup>	8A. ORIGIN INSTR <sup>a</sup>	8B. SPECIFIC DATA - CONTRACTOR ACCESS	9. LEVEL OF SUM
791001	H. TERM	U	U	NA	NL	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	A. WORK UNIT
10. NO. CODES	PROGRAM ELEMENT	PROJECT NUMBER		TASK AREA NUMBER	WORK UNIT NUMBER		
	61101A	3A161101A91C		00	408		
B. CONTRIBUTING							
C. CONTRIBUTING							
11. TITLE (Precede with Security Classification Code) <sup>a</sup>							
(U) The Effect of Cement Kiln Dust on Wound Healing in Experimental Animals							
12. SCIENTIFIC AND TECHNOLOGICAL AREAS <sup>a</sup>							
002300 Biochemistry 012900 Physiology							
13. START DATE		14. ESTIMATED COMPLETION DATE		15. FUNDING AGENCY <sup>a</sup>		16. PERFORMANCE METHOD	
7906		8004		DA		c. In House	
17. CONTRACT GRANT				18. RESOURCES ESTIMATE		19. PROFESSIONAL MAN YRS	
A. DATES/EFFECTIVE: NA				PRECEDING			
B. NUMBER <sup>a</sup>				FISCAL YEAR		C. FUNDS (in thousands)	
C. TYPE				80		0.2	
D. AMOUNT:				CURRENT		1	
E. KIND OF AWARD:				81		NA	
F. CUM. AMT.				NA		NA	
20. RESPONSIBLE DOD ORGANIZATION				20. PERFORMING ORGANIZATION			
NAME <sup>a</sup> U. S. Army Institute of Dental Research				NAME <sup>a</sup> U. S. Army Institute of Dental Research			
ADDRESS <sup>a</sup> Washington, DC 20012				Division of Oral Biology			
				ADDRESS <sup>a</sup> Washington, DC 20012			
RESPONSIBLE INDIVIDUAL				PRINCIPAL INVESTIGATOR (Furnish SSAN if U.S. Academic Institution)			
NAME COL Thomas P. Sweeney, DC				NAME <sup>a</sup> G. C. Battistone, Ph.D.			
TELEPHONE: 202 - 576-3484				TELEPHONE: 202 - 576-2987			
21. GENERAL USE				SOCIAL SECURITY ACCOUNT NUMBER:			
Foreign Intelligence Considered				ASSOCIATE INVESTIGATORS			
				NAME: Robert A. Miller			
				NAME:			
22. KEYWORDS (Precede EACH with Security Classification Code)							
(U) Wound Healing; (U) Bone Injury; (U) Cement Kiln Dust; (U) Trace Elements							
23. TECHNICAL OBJECTIVE <sup>a</sup> , 24. APPROACH, 25. PROGRESS (Furnish individual paragraphs identified by number. Precede text of each with Security Classification Code.)							
<p>23. (U) Experimental evidence has been obtained that a by-product of cement manufacture, cement kiln dust (CKD), when fed to steers as a substitute for major and trace element salts, resulted in improved growth and meat quality on less feed. The effect of improved growth on less feed was also noted in rats and sheep. The objective of the present study is to determine if rats fed CKD also demonstrate improved healing during the period of improved growth.</p> <p>24. (U) Weanling rats will be maintained on diets duplicating the original experiments with and without CKD, for a period of 4 weeks. All animals will be subjected to a reproducible bone injury and feeding will continue for 4 more weeks. Healing in the controls and experimentals will be evaluated histologically. Collagen and selected major and trace elements will also be determined quantitatively in repair tissue.</p> <p>25. (U) (7910-8010) Animals given the closest possible duplication of the original experimental diet, containing cement kiln dust, showed slight, but not significant, growth improvement when compared to control animals given the same diet with a normal salt fraction rather than cement kiln dust. It was noted however that the experimental animals did show significantly improved growth over animals given a chemically defined diet with cement kiln dust added. In no case was it possible to demonstrate improved bone healing above control levels in any experimental animals given cement kiln dust. The study was terminated.</p>							

<sup>a</sup> Available to contractors upon originator's approval

DD FORM 1498

PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE. DD FORMS 1498A 1 NOV 65 AND 1498-1 1 MAR 66 (FOR ARMY USE) ARE OBSOLETE

PROJECT NUMBER 3M161102BS10

ACCELERATION OF WOUND HEALING

Identification of Leukocyte Populations Responsible for the  
Production of Osteoclast Activating Factor and Their Role  
In Bone Resorption

The purpose of this project was to isolate and purify the lymphokine, osteoclast activating factor (OAF) and to produce an anti-OAF antibody. In FY 1978 and 1979 a precise in vitro bone resorption bioassay technique was perfected and a reliable method of producing OAF was developed using leukocytes obtained from the plateletphoresis center at the National Institutes of Health. OAF was concentrated from MNC supernatants and partially purified using ultra-filtration, gel filtration, high performance liquid chromatography (HPLC) and ammonium sulfate fractionation techniques.

In FY 1980, HPLC analysis of 85-100% ammonium sulfate fractions of ultra-filtration concentrated MNC supernatants yielded two peaks with high OAF activity with molecular weights of 9,000 and 18,000 Daltons. When HPLC fractions representing 9,000 Daltons, were rechromatographed by HPLC, a peak of 18,000 Daltons as well as 9,000 Daltons was found. This result suggests the reassociation of a 9,000 Dalton monomer into an 18,000 Dalton dimer and helps to resolve the conflicts in the scientific literature regarding the molecular weight of OAF.

Also, in FY 1980, our PHA-stimulated MNC began to produce relatively large amounts of a low molecular weight (less than 1,000) substance with bone resorbing activity. This substance was identified by radioimmunoassay as a prostaglandin of the PGE type. This development has caused several problems in the purification of OAF because it is necessary to determine if the bone resorbing activity detected in the bioassay is due to OAF or to the prostaglandin. The causes of the unexpected appearance of prostaglandin and methods for removing it or preventing its formation are being investigated.

RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY				1. AGENCY ACCESSION <sup>a</sup>	2. DATE OF SUMMARY <sup>a</sup>	REPORT CONTROL SYMBOL	
				DA OB 6137	80 10 01	DD-DR&E(AR)636	
3. DATE PREV SUMRY	4. KIND OF SUMMARY	5. SUMMARY SCTY <sup>a</sup>	6. WORK SECURITY <sup>a</sup>	7. REGRADING <sup>a</sup>	8. ORIGIN INSTR <sup>a</sup>	9. SPECIFIC DATA - CONTRACTOR ACCESS	10. LEVEL OF SUM
79 10 01	D. Change	U	U	NA	NL	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	A. WORK UNIT
11. NO. CODES <sup>a</sup>	PROGRAM ELEMENT	PROJECT NUMBER		TASK AREA NUMBER	WORK UNIT NUMBER		
a. PRIMARY	61102A	3M161102BS1Q		DA	361		
b. CONTINUING/	61102A	3S161102BS06		00	009		
c. CONTINUING/	STOG 80-7.2:5						
11. TITLE (Precede with Security Classification Code) <sup>a</sup>							
(U) Acceleration of Wound Healing							
12. SCIENTIFIC AND TECHNOLOGICAL AREAS <sup>a</sup>							
002300 Biochemistry							
13. START DATE		14. ESTIMATED COMPLETION DATE		15. FUNDING AGENCY		16. PERFORMANCE METHOD	
66 07		CONT		DA		C. IN-HOUSE	
17. CONTRACT/GRANT				18. RESOURCES ESTIMATE		19. PROFESSIONAL MAN YRS	
a. DATES/EFFECTIVE:				PRECEDING		b. FUNDS (in thousands)	
b. NUMBER: NA				FISCAL YEAR		80	
c. TYPE:				CURRENT		0.5	
d. KIND OF AWARD:				81		2.0	
e. CUM. AMT.						145.0	
19. RESPONSIBLE DOD ORGANIZATION				20. PERFORMING ORGANIZATION			
NAME: US Army Institute of Dental Research				NAME: US Army Institute of Dental Research			
ADDRESS: Washington, DC 20012				Division of Oral Biology			
				ADDRESS: Washington, DC 20012			
RESPONSIBLE INDIVIDUAL				PRINCIPAL INVESTIGATOR (Furnish SSAN if U.S. Academic Institution)			
NAME: Sweeney, T.P., COL, DC				NAME: Hawley, C., COL, DC			
TELEPHONE: 202-576-3484				TELEPHONE: 202-576-3764			
21. GENERAL USE				SOCIAL SECURITY ACCOUNT NUMBER:			
Foreign Intelligence Considered				ASSOCIATE INVESTIGATORS			
				NAME: Grower, M.F., LTC, DC			
				NAME: Hollinger, J., MAJ, DC Miller, R.A., BS			
22. KEYWORDS (Precede EACH with Security Classification Code)							
(U) Gingival Healing (U) Electrical Stimulation							
(U) Prostaglandin (U) Wound Healing (U) Bone Resorption (U) Osteoclast Activating Factor							
23. TECHNICAL OBJECTIVE, 24. APPROACH, 25. PROGRESS (Furnish individual paragraphs identified by number. Precede text of each with Security Classification Code.)							
25. (U) Recent studies show that 10-12% of combat wounds involved the maxillofacial apparatus. Further, 7% of noncombat injuries requiring hospital care involve the maxillofacial region. This results in the loss of approximately 1,000,000 man-hours per year. The research objective is to accelerate or otherwise improve the healing of maxillofacial injuries.							
24. (U) Studies on the effects of biochemical and physical factors to include chelate complexes, cyclic AMP, prostaglandins, and in vivo growth factors on the rate of healing in soft tissue and bone will be done. The mechanism of any beneficial alteration in healing effected will be investigated and pursued to human usage.							
25. (U) (79 10 - 80 10) Evidence has been obtained that the bone resorption factor, osteoclast activating factor (OAF) has a molecular weight in the range of 9000 daltons and may exist as both a monomer and an 18000 dalton dimer. Purification of OAF is in progress. A powerful bone resorption activity has also been found in the molecular weight range 1000-9000 daltons. Effort is being concentrated on the characterization of this potentially significant substance. The possible stimulating effect of a PLA-PGA copolymer dressing on gingival healing was studied. No significant improvement was found above control levels. The intermittent use of low-level direct current on healing skin and connective tissue was also found to be without effect on healing over a 14-day period. Preliminary results of a study on the effect of a diphosphonositide-lysozyme mixture on bone wounds suggest early stimulation of bone healing.							
MILITARY RELEVANCE CERTIFIED UNDER SECTION 204 (FY FUJDS)							
BY: Edward A. Bishop							

<sup>a</sup> Available to contractors upon originator's approval.

DD FORM 1498  
1 MAR 68

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Finally, preliminary investigations with Sephacryl S200 fractions of ultrafiltration concentrated MNC supernatants have shown the presence of a powerful bone resorption inhibitor with a molecular weight between 1,000 and 9,000 Daltons. Further purification and characterization of this substance is underway.

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#### Effects of Biodegradable Polylactic Acid Mesh on Gingival Flap Healing.

While the reactions involved in the healing of the gingiva after surgery have been extensively studied, the mechanisms of repair have not been fully elucidated. In vitro studies utilizing fibroblasts have shown that lactic acid may stimulate collagen formation. The object of this study was to determine if the lactic acid released during degradation of polylactic acid (PLA) mesh implants would stimulate gingival healing. Facial partial thickness flaps of the attached and alveolar mucosa of the maxillae and mandible were performed on 6 Rhesus monkeys. The right sides served as the controls while the left sides had strips of PLA mesh 5 mm in width placed under the flap before repositioning and suturing with 4-0 Dexon sutures. Full thickness flaps were used to remove the attached gingiva and 3-4 mm of alveolar mucosa at 7 and 14 days post-surgery. The excised tissues were evaluated on clinical appearance, collagen content, cyclic nucleotide content, and histologic response. Clinically, both areas showed good healing with minimal inflammation. Polymer was seen in some flaps at 7 days but not at 14 days. Both the collagen and cyclic nucleotide content of control and experimental areas were similar at 7 and 14 days. Histologic analysis did not show any difference in fibroblast growth, acute

inflammation, or collagen fibers in either group. Residual PLA, evident at 7 and 14 days, was associated with macrophages and some giant cells. Epithelial repair of both sites was similar. In conclusion, it was shown that the lactic acid released from PLA mesh did not appear to stimulate gingival flap healing.

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Effects of Periodontic Dressings Made from PLA/PGA  
and Coe Pak on the Synthesis of Prostaglandin E in  
Healing Gingival Wounds

Prostaglandin E has been implicated as an agent involved in the mediation of tissue inflammation and epithelial migration. In vitro studies have also shown that PLA (polylactic acid) can stimulate the production of collagen by fibroblasts in tissue culture. The object of this study was to determine if wound dressings of PLA/PGA could modify the rate of wound healing of the tissues and whether the effect might be due to regulation of tissue prostaglandin levels.

The effects that a dressing of 50% PLA and 50% PGA had on wound healing was studied in six Rhesus monkeys. The model system used to study oral wound healing was a gingivectomy done on the facial aspect of the maxillary and mandibular arches from the lateral incisors to the second molars.

The gingivectomies done on each animal were done in equal quadrants. The control areas were dressed with Coe Pak and the experimental with a dressing of 50% PLA/50% PGA. The plain PLA/PGA dressing was derived from a methylene chloride solution of PLA/PGA which had been sprayed on a glass slab. Tissue samples for biochemical analysis and histological evaluation were taken at zero time, 7 days and 14 days.



Analysis of homogenates of the gingival samples by radioimmunoassay for their prostaglandin E (PGE) content showed that the control tissue taken at the time of initial surgery had a PGE content of  $556 \pm 227$  to  $700 \pm 134$  picograms of PGE per mg of gingival protein. Seven days after surgery tissue covering with Coe Pak had a PGE content of  $1283 \pm 746$  pg PGE/mg protein while the PLA/PGA covered tissue was  $1329 \pm 445$  pg PGE/mg protein. At 14 days post-surgery the PGE content had increased in Coe Pak covered sites to  $1905 \pm 741$  pg PGE/mg protein while the PLA/PGA covered tissue contained  $1758 \pm 416$  pg PGE/mg protein. Statistical analysis did not show any significant differences in PGE content between the Coe Pak and PLA/PGE covered sites, although analysis did show significant increases in both groups from the levels of PGE seen in uninjured tissues. Statistical analysis of the changes in collagen content of the repair tissue using Friedman's 2-way analysis of variance showed that the dressing did not have a statistical effect on the collagen content.

Histologic analysis of the repair areas showed similar healing responses without any undue toxic reactions to any of the agents used.

In conclusion it was found that while prostaglandin E appears to be involved in the healing responses of injured tissues, wound dressing made of PLA/PGA do not have any effect on the PGE levels any different than that of the commercially available wound dressing of Coe Pak.

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## Effects of Electrical Stimulation on Wound Healing and Mediators of Tissue Responses

The formation of keloids and hypertrophic scars is a serious problem in the recovery from extensive trauma which could be expected to occur in combat situations. The object of this initial study was to determine the effect of electrical stimulation of wounds on the biochemical mediators of wound healing as well as wound parameters. The factors studied were:

1. Collagen content of the wound.
2. Cyclic AMP and cyclic GMP content of the wound.
3. Histologic changes in the wound.

The study was done on 16 rats which had wounds 20 mm in diameter produced by cutting out circular sections of the skin and connective tissue down to the muscle layer. One wound was placed in the back near the anterior legs while the second wound was placed in the back near the rear feet. The animals were divided into two groups of eight rats. Group A was stimulated with 13 volts of DC current which prolonged MA of current in the wound area. The positive electrode was placed in the center of the wound while the circular negative electrode was placed on the outside of the wound. Four of the rats had the anterior wound stimulated while the other four had the posterior wound stimulated. Group B differed from Group A in that the negative electrode was placed in the center of the wound while the circular positive electrode was placed on the outside of the wound.

The animals were stimulated for 14 days for a period of one minute each day.

Biochemical analysis of the rat skins showed that the collagen content of the skin removed at Day 0 (control tissue) was  $31.5 \pm 1.9$  (N = 15)  $\mu\text{g}$  of hypro/mg dry weight tissue for Group A and  $29.6 \pm 1.8$  (N = 15)  $\mu\text{g}$  of hypro/mg dry weight for Group B. Stimulated wounds analyzed at 14 days showed similar collagen levels to that seen at Day 0, Group A =  $31.9 \pm 2.5$   $\mu\text{g}$  hypro/mg tissue, Group B =  $28.9 \pm 4.2$   $\mu\text{g}$  hypro/mg tissue. Thus electrical stimulation did not appear to have a significant effect on tissue collagen levels in the skin wounds.

The cyclic AMP content of the 14-day repair tissue showed a two-fold increase from that seen at Day 0 but no difference was evident between stimulated and unstimulated groups. (The cAMP content at Day 0 was  $0.27 \pm 0.03$  picomoles cAMP/mg wet weight of tissue and total content of the stimulated tissue was  $0.61 \pm 0.2$  picomoles cAMP/mg wet weight of tissue.

The cyclic GMP content of the skin at initial sampling was 0.008 picomoles cGMP/mg wet weight of tissue and a slight but not significant increase to  $0.0125 \pm 0.002$  picomoles cGMP/mg wet weight of tissue was seen in the electric stimulated group as opposed to the control group which showed a decrease from that seen at Day 0.

Histologic analysis of the stimulated wounds versus the unstimulated wounds did not show any significant differences in the healing responses observed based on collagen content, inflammation, muscle degeneration, or degree of epithelial closure.

In summary it was shown that stimulation of wound with an electric current for only one minute each day did not retard nor did it stimulate wound healing

or significantly modify any of the parameters involved in wound healing. It may be that stimulation has to be of a continuous nature in order to observe significant effects.

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#### Osseous Wound Healing

Numerous investigations have been conducted using a variety of implant materials to promote healing of osseous injuries. Polymers and copolymers of polylactic and polyglycolic acids have shown promise when used as implants for bone fracture repair. Reports have indicated that a protein bound phospholipid (diphosphoinositide) complex can cause nucleation of bone calcification, in vitro.

To date, no study has investigated the combination of a polylactic acid-polyglycolic acid matrix and a protein bound phospholipid to determine what effects this complex would have on osseous wound repair.

A pilot study was initiated to determine the relative effects of polylactic-polyglycolic acid copolymer plugs and a diphosphoinositide-lysozyme (DPL) paste placed in the 2 mm diameter holes in the tibias of rats. Each animal was wounded in both tibias so that one tibia received the experimental material and the other was left unfilled as a control. The results indicated that the solid copolymer tended to slow down bone deposition while the DPL treated wounds tended to show improved bone deposition. These preliminary results suggest that appropriate combinations of copolymer and DPL may be more effective in resolving maxillofacial bone defects than copolymer alone. This study is continuing.

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3. Grower, M.F., and Stow, J.A.: Effects of Sodium Fluoride on In Vivo Levels of Cyclic Nucleotides in Gingiva and Bone. J Dent Res, 59 (Spec Issue A):536, 1980.
4. Grower, M.F., Carpenter, W.M., and Stow, J.A.: Effects of Biodegradable Polylactic Acid Mesh on Gingival Flap Healing. Submitted to 1981 IADR.
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RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY				1. AGENCY ACCESSION <sup>a</sup>	2. DATE OF SUMMARY <sup>a</sup>	REPORT CONTROL SYMBOL DD-DH&E(AIR) <sup>a</sup>	
3. DATE PREV SUMMARY	4. KIND OF SUMMARY	5. SUMMARY SCTY <sup>a</sup>	6. WORK SECURITY <sup>a</sup>	7. REGRADING <sup>a</sup>	8. DESGN INSTN <sup>a</sup>	9. SPECIFIC DATA CONTRACTOR ACCESS	10. LEVEL OF SUM A. WORK UNIT
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10. NO./CODES <sup>a</sup>	PROGRAM ELEMENT	PROJECT NUMBER	TASK AREA NUMBER	WORK UNIT NUMBER			
6. PRIMARY	61102A	3M161102BS10	DA	362			
<del>7. SECONDARY</del>	<del>61102A</del>	<del>3S161102BS06</del>	<del>00</del>	<del>010</del>			
11. TITLE (Precede with Security Classification Code) <sup>a</sup> (U) Problems Involved in Military Oral Health Care Delivery Related to Therapeutic Agents and Materials							
12. SCIENTIFIC AND TECHNOLOGICAL AREAS <sup>a</sup> 012600 Pharmacology 002300 Biochemistry 010100 Microbiology							
13. START DATE		14. ESTIMATED COMPLETION DATE		15. FUNDING AGENCY		16. PERFORMANCE METHOD	
68 09		CONT		DA		C. IN-HOUSE	
17. CONTRACT/GRANT				18. RESOURCES ESTIMATE		19. PROFESSIONAL MAN YRS	
A. DATES/EFFECTIVE:				PRECEDING		B. FUNDS (in thousands)	
B. NUMBER <sup>a</sup> NA				FISCAL YEAR		80 3.0 135	
C. TYPE				CURRENT		81 3.0 150	
E. KIND OF AWARD:				F. CUM. AMT.			
20. RESPONSIBLE DOD ORGANIZATION				21. PERFORMING ORGANIZATION			
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ADDRESS <sup>a</sup> Washington, DC 20012				ADDRESS <sup>a</sup> Washington, DC 20012			
RESPONSIBLE INDIVIDUAL				PRINCIPAL INVESTIGATOR (Furnish SSAN if U.S. Academic Institution)			
NAME: Sweeney, T.P., COL, DC				NAME <sup>a</sup> Grower, M.F., LTC, DC			
TELEPHONE: 202-576-3484				TELEPHONE: 202-576-3678			
22. GENERAL USE				SOCIAL SECURITY ACCOUNT NUMBER:			
Foreign Intelligence Considered				ASSOCIATE INVESTIGATORS			
				NAME: Setterstrom, J., Ph.D., Snyder, A., COL, DC			
				NAME: Wynkoop, J., CPT, DC, Miller, R.A., BS			
23. WORDS (Precede EACH with Security Classification Code) <sup>a</sup> (U) Microencapsulation (U) Biodegradable Copolymers (U) Antibiotics (U) Mercury Intoxication (U) Tetracycline							
24. TECHNICAL OBJECTIVE, 25. APPROACH, 26. PROGRESS (Furnish individual paragraphs identified by number. Precede text of each with Security Classification Code.)							
<p>23. (U) To evaluate the special military problems of drug storage, heat susceptibility, long-term drug potency, sterility of bulk items, lack of refrigeration in combat zones and delivery to the patient. To investigate drug hazards. To investigate the use of biodegradable polymers for the long term, slow release delivery of drugs.</p> <p>24. (U) Improved means of drug delivery in the field using microencapsulated medicaments will be studied. The hazards in the use of various drugs and the use of biodegradable, biocompatible materials for surgical repair of combat wounds will be studied.</p> <p>25. (U) (79 10 - 80 - 10) Single dose, topically applied, ampicillin-containing microcapsules made of a polylactic-polyglycolic acid copolymer were found to be highly effective in eliminating mixed infections in avulsive muscle wounds in experimental animals within 14 days when given immediately after infection. Infections which were permitted to stand 24 hours prior to treatment were diminished but not eliminated within 14 days. A device for segmental replacement of the trachea was constructed of biodegradable polylactic acid and biocompatible ceramic rings. Studies in experimental animals showed soft tissue replacement of the PLA framework but collapse of the ceramic rings into the lumen. An improved design is being developed. A study of the effect of mercury on renal transport is in progress. A study on the effect of systemic tetracycline on the mechanism of new periodontal attachment is in progress.</p>							
<p>MILITARY RELEVANCY CERTIFIED UNDER SECTION 204 (FY 66 FUNDS) BY <i>James A. Schief</i></p>							

<sup>a</sup> Available to contractors upon originator's approval.

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AND 1498-1 1 MAR 66 (FOR ARMY USE) ARE OBSOLETE.

PROJECT NUMBER 3M161102BS10

PROBLEMS INVOLVED IN MILITARY ORAL HEALTH

CARE DELIVERY RELATED TO THERAPEUTIC AGENTS AND MATERIALS

Biological Activity Verification of Specified Microencapsulated  
Antibiotics In Vivo

The proven effectiveness of antibiotics in the prevention of infection in contaminated wounds following traumatic injury is of obvious military significance. Improvement of techniques of administration to give rapid sustained levels of antibiotic in wound fluids will enhance our present abilities to successfully fight infection. It is the purpose of this study to evaluate in vivo the local application of PLA-PGA microencapsulated, slowly released antibiotics for the control of wound infection.

To test the efficacy of microencapsulated ampicillin, mixed infections with Streptococcus pyogenes and Staphylococcus aureus were induced in the hind legs of rats. Each wound was immediately packed with ampicillin microcapsules. Microbiologic assays were performed at timed intervals to determine the bacterial counts per gram of tissue, and these results were compared with those obtained for the control group. Twenty-four hours post-infection the wounds containing microcapsules showed reduced bacterial counts compared with controls. At three and seven days, all controls were manifesting infections and high microbial counts. The experimental rats, however, were infection-free as evidenced by negative cultures. In the 14-day group the majority of test rats were also free of infection.

Results suggest that microencapsulated ampicillin was, in most instances, successful in preventing the described mixed infection when applied immediately following inoculation of the wound with pathogens. Although all streptococci

were killed, there was evidence of staphylococcal persisters present in small numbers in the 14-day group. It is possible that these persisters were due to L-form formation or resistance of the organism by induced penicillinase production. We are presently determining the cause of the occasional persisters, and the optimal dose and time release profiles for complete infection control.

Similar studies have also been completed on 24-hour established infections. Although the microbial counts of tissue treated with microencapsulated ampicillin following a 24-hour established infection were lower than those of the control group, the infection was not eradicated at 14 days. Although disappointing, this was not surprising in view of the numerous reports, both experimental and clinical, showing that early antibiotic administration is necessary to obtain the best results. Studies are continuing to define optimal conditions that influence the successful control of infection using this new approach of antibiotic administration.

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#### Construction of Biodegradable and Biocompatible Devices for Tracheal Reconstruction

The objective of this study was to construct a device which can be used to repair surgically created defects in the continuity of the dog trachea. The ultimate aim of this work is to provide implant materials which can be used in hollow organ reconstruction following traumatic injury.

The tracheal prosthesis was fabricated on a teflon mandril, 23 mm in diameter and 150 mm in length. The mandril was dipped in a solution of polylactic acid, 10 g per 100 ml of methylene chloride solvent and let air dry.



It was then placed on a rotating apparatus and while rotating was sprayed successively with 50 ml of polylactic acid solution (10 gm PLA supplied by Southern Research Institute per 100 ml methylene chloride), then with a 20 ml 40/60 polylactic acid/polyglycolic acid solution (8 gm of 40/60 PLA/PGA supplied by Ethicon, Inc, per 100 ml methylene chloride), and finally with 20 ml of polylactic acid solution (10 gm PLA supplied by Southern Research Institute, per 100 ml methylene chloride). Biocompatible ceramic rings, 3 mm wide by 25 mm outside diameter were then placed on the coated mandril, 4 rings per 45 mm of mandril length. Each was placed 5 mm from each other except at each end of the successive 45 mm segments where 15 mm were left between the rings to allow for cutting the mandril-supported tube into 3 separate prostheses and for suture placement.

The mandril was again sprayed while rotating, with the same solutions successively in the same order as above but with 35 ml, 20 ml, and 40 ml of each respectively and finally sprayed with 40 ml of the 8 gm/100 ml solution followed by 40 ml of the 10 gm/100 ml solution.

The prosthesis on the mandril was then placed in a sealed glass cylinder for 12 hours. From this point, the mandril was again set rotating and in sequence:

1. Sprayed with 40 ml polylactic acid solution.
2. Sprayed with 10 ml 75/25 polylactic acid/polyglycolic acid solution.
3. Sprayed with 40 ml polylactic acid solution.
4. Sprayed with 10 ml polylactic acid solution (8.7 gm/100 ml).
5. Sprayed with 10 ml polylactic acid solution (8 gm/100 ml).
6. Sprayed with 20 ml polylactic acid solution (10 gm/100 ml).

The prosthesis was lyophilized for 72 hours and then cut into 3 segments with final length of 45 mm each and separated from the mandril.

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#### Pilot Study of the Effect of Mercury on Renal Transport

Twenty Sprague-Dawley rats were injected subcutaneously with 1, 2, or 5 mg/kg of mercuric chloride after five 24-hour urine samples were obtained from each animal. Following injection, 24-hour urine specimens were collected for five days and the changes in urinary proteins were evaluated using isoelectric focusing. The control samples consistently demonstrated major banding in the pH range of 5.35 - 5.65 and minor banding in the pH range 5.65 - 5.90, with an apparent loss of a major band in the 5.35 - 5.56 range. This pilot study was demonstrated alterations in urinary protein patterns after acute mercury poisoning. Currently, two new studies are being designed, (1) to identify the urinary proteins which have been altered, and (2) to evaluate chronic mercury poisoning using urinary protein patterns.

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#### An Evaluation of the Effects of Systemic Tetracycline on the Mechanism of New Periodontal Attachment

The project has thus far been completed on seven monkeys. Although histologic evaluation of the experimental side varied from the control side as anticipated, a highly undesirable variable - - plaque associated with inflammation, was present on the monkeys sacrificed at 14 and 28 days. It is felt that this variable will interfere with the interpretation of results and the achievement of research objectives. A recent communication by Caton suggests that

plaque control measures are necessary every two days to maintain health. Based upon this information, a revision of the plaque control measures being utilized has been submitted. This revision primarily states that scaling and polishing procedures will be accomplished followed by plaque removal by toothbrushing and a 3 minute application of chlorhexidine gluconate 3 times a week until gingival inflammation is eliminated. (The original project called for cleaning procedures only 2 times/week.)

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PROJECT NUMBER 3M161102BS10

IDENTIFICATION AND CONTROL OF OROFACIAL INFECTIONS

Effect of Chlorhexidine on Inhibition of Bacterial HA Activity of *Bacteroides melaninogenicus*, *Fusobacterium nucleatum*, and *Leptotrichia buccalis*.

Among the antibacterial agents suggested for the control of oral bacteria, chlorhexidine has shown bactericidal and plaque inhibiting effects. The purpose of this study was to determine the potential effect of chlorhexidine on the adherence of oral *Bacteroidaceae* to eukaryotic cell membranes using a standardized microtiter hemagglutination assay (HA). *Leptotrichia buccalis*, *Fusobacterium nucleatum*, and *Bacteroides melaninogenicus* were grown anaerobically. Log phase cultures were harvested and ultrasonically disrupted. Ten per cent cell wall suspensions of *B. melaninogenicus*, *L. buccalis*, and *F. nucleatum* showed baseline HA activity at 1:1, 1:1, and 1:16 dilutions, respectively. After washing the cell walls with 1% chlorhexidine digluconate (CH) all cell walls produced HA at 1:4 dilutions. Heat treatment of the cell walls (100C) eliminated all HA activity prior to CH washing and had no effect on the 1:4 HA activity shown after CH exposure. The baseline HA shown by *F. nucleatum* cell walls (1:16) could be restored by washing the CH treated cell walls with 100 mM  $\text{CaCl}_2$ . This study indicated that CH will adsorb to bacterial cell walls and when so bound has HA activity which dominates and is independent of the bacterial cell wall HA moiety. The displacement of CH by divalent cations suggests an electrostatic interaction between CH and the cell walls. Because of its unique and sterically dominant HA activity, CH may affect the colonization of mucosal surfaces.

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Identification and Control of Orofacial Infections  
Evaluation of Sporicidin

The glutaraldehyde based disinfectants Sonicide, Cidex, and Sporicidin have been approved by the FDA as potent cold-sterilizing agents. Manufacturers of Sporicidin (first marketed in 1979) claim that a synergistic effect created by the addition of 7% phenol allows an effective dilution, thirty times that for Cidex or Sonicide, thereby creating a more economical disinfectant. Furthermore, through product dilution, the undesirable effects of odor and chemical residue usually observed when undiluted (2%) glutaraldehyde products are used, could possibly be eliminated. Such a dilute, effective form of glutaraldehyde would be of value in dental clinics for the disinfection of rubber products (such as the nasal hood and tubing of the nonrebreathing N<sub>2</sub>O<sub>2</sub> inhalation sedation equipment) as well as nonautoclavable pieces of equipment. Such a method is essential to prevent the transmission of hepatitis virus and/or bacterial pathogens such as *Mycobacterium tuberculosis*.

It was the purpose of this study to evaluate Sporicidin using the Official Methods of Analysis of the Association of Official Analytical Chemists (AOAC) by performing the AOAC spore test, determining the highest dilution of Sporicidin active as a sterilizing agent, and the lowest concentration active as a disinfectant. Both the AOAC use-dilution and tuberculocidal tests were performed. Results showed with 95% confidence that following a 6-3/4 hour exposure time, a 1:5 dilution of Sporicidin killed all spores of *Clostridium sporogenes* and *Bacillus subtilis*. Cidex, however, required 10 hours of exposure at full strength to achieve the same effect. Sporicidin was

bactericidal at 1:30 and tuberculocidal at 1:20. Studies were done at 0, 7, and 14 days following activation of the sterilizing agents. Previous studies by the EPA on these products were performed only on undiluted products. This study has determined that although EPA requirements for classifying a sterilizing agent were satisfied by Cidex, they were exceeded by Sporidicin.

In summary, the manufacturer's claim that undiluted Sporidicin is sporicidal, following a spore exposure time of 6-3/4 hours, was confirmed. The product was found to have the same sporicidal efficacy at a 1:5 dilution; indicating an increased effectiveness over Cidex, which was sporicidal only when undiluted. It is important to note that although Sporidicin was tuberculocidal at a 1:20 dilution, it failed at 1:30.

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The Rapid Serologic Identification of Oral Gram Negative  
*Bacteroidaceae* in Anaerobic Wound Infections

The serologic thrust of this task has been abandoned temporarily pending the development of ELISA technology. We have, however, begun to analyze differences in biochemical parameters between closely related strains of *Fusobacterium* using microanalysis methodology. Previously prepared and frozen (-70C) sonicate supernatants obtained from *Fusobacterium polymorphum* and *Fusobacterium fusiforme* were thawed and adjusted to a final protein concentration of 3.2 mg/ml. Isoelectric focusing (IEF) was performed across commercially available IEF gels (LKB) over a range of pH 3.5 to pH 9.5. Gels were stained with Coomassie blue. Each sample (n=7) showed an apparent strain specific heterogenous destruction of protein bands in the anodal half of the test gel. A narrow range gel (pH 4 - pH 6.5) was then utilized to improve resolution of strain differences in IEF profiles. The differences seen in the pH 3.5 to



pH 9.5 gels were repeated in the pH 4 to pH 6.5 gels. In addition, the IEF profiles for each sample were constant for each parent *Fusobacterium* strain. Further studies to separate and identify strain specific proteins and to correlate isoelectric points with these proteins is currently underway.

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The Rapid Serologic Identification of Oral Gram  
Negative *Bacteroidaceae* in Anaerobic Wound  
Infections

A parallel investigation indicated that two prototype strains of oral *F. nucleatum* may be distinguished on the basis of long chain fatty acid profiles by high performance liquid chromatography (HPLC). *F. nucleatum* ATCC 10953 and *F. nucleatum* ATCC 23726 were grown anaerobically and log phase cultures were harvested and washed. The bacterial fatty acids were saponified, extracted, and the phenylacyl esters prepared. The fatty acids were separated by HPLC methodology. They were also hydrogenated and treated with trifluoroacetic anhydride before HPLC. Six cultures of each strain were tested to establish confidence in the chromatographic profiles. The two strains of *Fusobacterium* contained the major fatty acids: myristic, palmitic, palmitoleic, stearic, and oleic acids. There were a series of fatty acid peaks in front of myristic acid with profiles which were characteristic of each organism and might provide the basis for future strain differentiation. The use of HPLC for examination of bacterial fatty acid profiles may prove to be a reliable technique for identification of closely related bacterial strains which to date have been indistinguishable by conventional taxonomic methods.

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An Investigation Into the Suspected Relationship of  
Military/Social Environmental Factors to ANUG Profile

A field study was conducted at Fort Bliss, Texas, from 7 to 24 May 1980 using a newly developed questionnaire for patients with Acute Necrotizing Ulcerative Gingivitis (ANUG). In addition to answering the questionnaire, patients were given an oral examination including ten intraoral photographs and a limited physical evaluation. During the seventeen-day period, ten suspected cases of ANUG were detected and interviewed. Of these ten possible cases, only eight manifested symptoms associated with the classical signs of ANUG. Insufficient number of cases were obtained to draw conclusions. Currently, a second field study is being planned to obtain further data.

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5. Russell, N.E., and Hawley, C.E. High Performance Liquid Chromatography in Taxonomic Studies. Abstract submitted for IADR for 1981.
6. Van Swol, R.L., Gross, A., Setterstrom, J.A., and D'Alessandro, S.M. Immunoglobins in Periodontal Tissues. II. Concentrations of Immunoglobulins in Granulation Tissue from Pockets of Periodontosis and Periodontitis Patients. J Periodontol 51(1):20-24, Jan 1980.
7. Setterstrom, J.A., Gross, A., D'Alessandro, S.M., and Godat, R.F. Immunoglobulins in Periodontal Tissues. III. Concentrations of Immunoglobulins in Dilantin-Induced and Idiopathic Gingival Hyperplastic Tissues. J Periodont 51(1):25-29, Jan 1980.

RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY					1. AGENCY ACCESSION <sup>a</sup>		2. DATE OF SUMMARY <sup>a</sup>		REPORT CONTROL SYMBOL DD-DR&E(AR)636														
3. DATE PREV SUMMARY <sup>a</sup>		4. KIND OF SUMMARY		5. SUMMARY SCTY <sup>a</sup>		6. WORK SECURITY <sup>a</sup>		7. REGRADING <sup>a</sup>		8. DES'N INSTR <sup>a</sup>		9. SPECIFIC DATA: CONTRACTOR ACCESS <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		10. LEVEL OF SUM A. WORK UNIT									
79 10 01		D. Change		U		U		NA		NL													
10. NO / CODES: <sup>a</sup>		PROGRAM ELEMENT		PROJECT NUMBER		TASK AREA NUMBER		WORK UNIT NUMBER															
a. PRIMARY		62772A		3S162772A875		AD		001															
b / <del>60479/60479/60479</del>		61102A		3S161102BS06		00		013															
c / <del>60479/60479/60479</del>		STOG 80-7.2:1																					
11. TITLE (Precede with Security Classification Code) <sup>a</sup>																							
(U) Study of Saliva as a Diagnostic Tool for Presence of Lethal Agents																							
12. SCIENTIFIC AND TECHNOLOGICAL AREAS <sup>a</sup>																							
002300 Biochemistry																							
13. START DATE				14. ESTIMATED COMPLETION DATE				15. FUNDING AGENCY				16. PERFORMANCE METHOD											
79 10				CONT				DA				C. IN-HOUSE											
17. CONTRACT, GRANT								18. RESOURCES ESTIMATE				19. PROFESSIONAL MAN YRS				20. FUNDS (in thousands)							
a. DATES/EFFECTIVE:								PRECEDING															
b. NUMBER: NA								FISCAL YEAR				80				1.0				80			
c. TYPE:								CURRENT															
d. KIND OF AWARD:								81				2.0				136							
21. RESPONSIBLE DOD ORGANIZATION								22. PERFORMING ORGANIZATION															
NAME: US Army Institute of Dental Research								NAME: US Army Institute of Dental Research															
ADDRESS: Washington, DC 20012								Division of Oral Biology															
								Washington, DC 20012															
RESPONSIBLE INDIVIDUAL								PRINCIPAL INVESTIGATOR (Furnish SSAN if U.S. Academic Institution)															
NAME: Sweeney, T.P., COL, DC								NAME: Bussell, N., MAJ, DC															
TELEPHONE: 202-576-3484								TELEPHONE: 202-576-3393															
								SOCIAL SECURITY ACCOUNT NUMBER:															
21. GENERAL USE								ASSOCIATE INVESTIGATORS															
Foreign Intelligence Considered								NAME: Miller, R.A., BS															
								NAME:															
23. KEYWORDS (Precede EACH with Security Classification Code)																							
(U) Diagnosis in Saliva (U) Salivary Protein																							
(U) Salivary Electrolytes (U) Saliva (U) Nerve Gas																							
24. TECHNICAL OBJECTIVE, 25. APPROACH, 26. PROGRESS (Furnish individual paragraphs identified by number. Precede text of each with Security Classification Code.)																							
23. (U) To determine if saliva can be used as a diagnostic tool in evaluating the exposure of combat troops to lethal agents. To determine if parameters in saliva can be used to monitor the progress of therapy for lethal agent exposure. Develop a rapid simplified field technique for identification of lethal agent exposure in the combat soldier.																							
24. (U) Changes in saliva produced by lethal agent exposure will be evaluated. The particular areas of study will be protein, electrolyte and immunological components. Possible methodology developed will be evaluated in the field and at the hospital level																							
25. (U) (79 10 - 80 - 10) Experimental animals (cynomologous monkeys) given a one LD50 dose of Sarin (GB) IV did not exhibit the characteristic increased salivary flow rate reported with organophosphate intoxication even though the clinical signs of intoxication were evident within 30 seconds. Antidote administration within 5 minutes of Sarin administration reduced the salivary flow rate to baseline levels. Salivary protein levels were increased by GB administration, returned to baseline level by atropine but remained elevated when TAB administration followed the GB dose. Amylase activity was decreased by GB and TAB but increased by other cholinergic drugs. Electrolyte studies indicated that GB causes an increase in salivary sodium. Calcium and potassium were unaffected by GB while other cholinergic drugs produced increases and decreases in salivary calcium and potassium respectively. It was further found that exposure to GB may compromise immunological defense mechanisms. This work is being transferred to the 6.2 program under project 875 (Chemical																							

MILITARY RELEVANCY CERTIFIED UN  
SECTION 204 (FY FUNDS)  
BY *[Signature]*

<sup>a</sup>Available to contractors upon originator's approval.

PROJECT NUMBER 3S162772A875

A STUDY OF SALIVA AS A DIAGNOSTIC TOOL FOR THE  
PRESENCE OF LETHAL AGENTS

One of the major concerns of the U.S. Army Medical Department is the survival of soldiers who have been exposed to tactical chemical weapons. In order to provide proper medical therapy, rapid diagnosis of exposure to CW weaponry, and in particular nerve agents, must be made. Presently, the methods of field diagnosis are based upon unreliable clinical signs. This investigation was undertaken to determine if a diagnostic test using saliva could be developed for nerve agent exposure. Cynomolgus monkeys were exposed to traditional cholinergic drugs and to the chemical warfare organophosphate agent, Sarin (GB).

It is evident from the data presented that Sarin did not produce the same effect as other cholinergic drugs on salivary gland function. The data clearly shows that Sarin did not increase the salivation rate and this findings is in direct disagreement with the previously reported characteristic signs of organophosphate intoxication.

Normally, increases of acetylcholine in the salivary glands would produce an increase of total protein, amylase activity, sodium and calcium concentrations, and a concomitant decrease in potassium concentration. Sarin produced only increases in protein and sodium, but it did not provide the parallel increases in calcium concentration and amylase activity or the decrease in potassium concentration. Sarin actually produced a slight decrease in salivary amylase activity. From the data, it is apparent that one of the major considerations of any agent is the central effect of the drug versus its potential peripheral effect. Sarin, under the conditions of this study, apparently displayed a primary CNS effect while the other cholinergic drugs were primarily peripheral

in their effect. Sarin closely resembles Soman (GD) in structure, and Soman, like Sarin, produces no salivary stimulation. On the other hand, VX does not readily cross biological membranes and therefore would be expected to have an entirely peripheral action which should produce activity parallel to the other cholinergic drugs tested here. If so, this fact may act to differentiate between the effects of the nerve agents GB or GD type from the effects of VX types.

More research is needed on other agents and on their response patterns before any conclusive recommendations can be made. Currently from the data, a hypothetical salivary dipstick could be designed to detect CW agent exposure. The dipstick would contain a set of three spots which would react with the following chemicals: one spot for salivary amylase which would indicate if a soldier has been exposed to a nerve agent, the second spot would be sensitive to magnesium which would indicate if the soldier had been given atropine or TAB, the third spot would act as a cross check on the first two spots by being sensitive to potassium which would indicate administration of both the CW agent and atropine.

Finally, the changes found in the oral cavity immunological defense mechanisms require further study. The findings suggest that exposure to CW agents may compromise the natural defense mechanism. If a soldier were to survive exposure to nerve agents, he would yet ultimately be lost. With a compromised immunological defense mechanism as such, he could be more susceptible to rampant infectious processes.

Publications:

1. Miller, R.A., Bussell, N.E., and Bongiovanni, R. The Effects of Organophosphate Poisoning and its Antidote on Amino Acid Levels in Saliva. J Dent Res 59:310, 1980. (Abstract)
2. Bussell, N.E., Miller, R.A., and Hawley, C.E. Preliminary Studies on the Effects of Organophosphate Chemical Warfare Agents on Oral Cavity Physiology. Army Science Conference, 1980. In press.
3. Miller, R.A., Bongiovanni, R., Boehm, T., Bussell, N.E., and Wynkoop, J.R., II: Reverse Phase HPLC Analysis by Dansylation of Amino Acids in Monkey Saliva. IN Biological/Biomedical Applications of Liquid Chromatography. 1979, in press.

RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY				1. AGENCY ACCESSION <sup>a</sup>	2. DATE OF SUMMARY <sup>a</sup>	REPORT CONTROL SYMBOL DD-DR&E(AR)636	
3. DATE PREV SUMRY	4. KIND OF SUMMARY	5. SUMMARY SCTY <sup>a</sup>	6. WORK SECURITY <sup>a</sup>	7. REGRADING <sup>a</sup>	8A. DDB'S INSTN <sup>a</sup>	8B. SPECIFIC DATA - CONTRACTOR ACCESS	9. LEVEL OF SUM
79 10 01	H. TERM	U	U	NA	NL	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	A. WORK UNIT
10. NO. CODES <sup>a</sup>	PROGRAM ELEMENT	PROJECT NUMBER	TASK AREA NUMBER	WORK UNIT NUMBER			
A. PRIMARY	62775A	3S162774A825	00	033			
B. CONTRIBUTING							
C. CONTRIBUTING							
11. TITLE (Precede with Security Classification Code) <sup>a</sup>							
(U) Development and Evaluation of Nitinol for Use in Dentistry							
12. SCIENTIFIC AND TECHNOLOGICAL AREAS <sup>a</sup>							
009900 Metallurgy and Metallography							
13. START DATE		14. ESTIMATED COMPLETION DATE		15. FUNDING AGENCY		16. PERFORMANCE METHOD	
71 04		NA		DA		C. IN-HOUSE	
17. CONTRACT GRANT				18. RESOURCES ESTIMATE		19. PROFESSIONAL MAN YRS	
A. DATES/EFFECTIVE				PRECEDING		B. FUNDS (In thousands)	
D. NUMBER <sup>a</sup> NA				FISCAL YEAR		C. CURRENT	
C. TYPE				80		0.3	
E. KIND OF AWARD				NA		40	
F. CUM. AMT.							
19. RESPONSIBLE DOD ORGANIZATION				20. PERFORMING ORGANIZATION			
NAME <sup>a</sup> US Army Institute of Dental Research				NAME <sup>a</sup> US Army Institute of Dental Research			
ADDRESS <sup>a</sup> Washington, DC 20012				Division of Dental Materials			
				ADDRESS <sup>a</sup> Washington, DC 20012			
RESPONSIBLE INDIVIDUAL				PRINCIPAL INVESTIGATOR (Furnish SSAN if U.S. Academic Institution)			
NAME <sup>a</sup> Sweeney, T.P., COL, DC				NAME <sup>a</sup> Huget, E.F., COL, DC			
TELEPHONE: 202-576-3484				TELEPHONE 202-576-3092			
21. GENERAL USE				SOCIAL SECURITY ACCOUNT NUMBER:			
Foreign Intelligence Considered				ASSOCIATE INVESTIGATORS			
				NAME: Russell, E.A., COL, DC			
				NAME:			
22. KEYWORDS (Precede EACH with Security Classification Code)							
(U) Nitinol (U) Shape Memory (U) Dental Devices (U) Osseous Fixation							
23. TECHNICAL OBJECTIVE, 24. APPROACH, 25. PROGRESS (Furnish individual paragraphs identified by number. Precede text of each with Security Classification Code.)							
<p>23. (U) To exploit the shape memory phenomenon of 55-nitinol for enhancement of the treatment capabilities of the Army dentist and physician. Realization of the conceptual uses of this unusual metal will result in substantial savings of laboratory costs and professional man-hours.</p> <p>24. (U) To design, fabricate, and test by means of animal studies, the following devices: (1) Flexible wire clasps that will withstand accidental deformation out of the mouth, yet recover in the mouth; (2) prestressed surgical fixation staples and plates that will bend or contract slightly at body temperature, bringing bone fragments into close approximation or under slight compression; (3) self-anchoring fixation pins and endosseous implant devices; (4) collapsible devices for placement into defects (cyst cavity, cleft palate, etc) through orifices smaller than the inside diameter; (5) fixed and removable prosthetic appliances, restorations or precision attachments that can move into undercuts in the mouth.</p> <p>25. (U) (79 10 - 80 10) Of the various devices tested only osseous fixation staples that bring bone fragments into close approximation at body temperature were found feasible. Additional applications do not appear practical at the present time due mainly to the cost of nitinol and potential problems of long term biocompatibility. Loss of the principal and associate investigators has necessitated termination of this project for the present time.</p>							

<sup>a</sup> Available to contractors upon originator's approval

DD FORM 1498

PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE. DD FORMS 1498A 1 NOV 85 AND 1498-1 1 MAR 88 (FOR ARMY USE) ARE OBSOLETE



RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY				1. AGENCY ACCESSION <sup>a</sup>	2. DATE OF SUMMARY <sup>a</sup>	REPORT CONTROL SYMBOL DD FORM 1498 (1 MAR 68)	
3. DATE PREV SUMMARY	4. KIND OF SUMMARY	5. SUMMARY SCTY <sup>a</sup>	6. WORK SECURITY <sup>a</sup>	7. REGRADING <sup>a</sup>	8A. DOWN INSTN <sup>a</sup>	8B. SPECIFIC DATA CONTRACTOR ACCESS	9. LEVEL OF SUM A. WORK UNIT
79 10 01	D. Change	U	U	NA	NL	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	
10. NO. CODES <sup>a</sup>	PROGRAM ELEMENT	PROJECT NUMBER	TASK AREA NUMBER	WORK UNIT NUMBER			
A. PRIMARY	62770A	3S162772A871	DA	001			
<del>1. F. P. A. B. C. D. E. F. G. H. I. J. K. L. M. N. O. P. Q. R. S. T. U. V. W. X. Y. Z.</del>	62775A	3S162775A825	00	031			
<del>1. F. P. A. B. C. D. E. F. G. H. I. J. K. L. M. N. O. P. Q. R. S. T. U. V. W. X. Y. Z.</del>	STOG 80-7.2:2						
11. TITLE (Precede with Security Classification Code) <sup>a</sup>							
(U) Preventive Dentistry Measures of Military Significance							
12. SCIENTIFIC AND TECHNOLOGICAL AREAS <sup>a</sup>							
012900 Physiology . 002400 Bioengineering							
13. START DATE		14. ESTIMATED COMPLETION DATE		15. FUNDING AGENCY		16. PERFORMANCE METHOD	
71 01		CONT		DA		C. IN-HOUSE	
17. CONTRACT GRANT				18. RESOURCES ESTIMATE		19. PROFESSIONAL MAN YRS	
A. DATES/EFFECTIVE:				PRECEDING		B. FUNDS (In thousands)	
B. NUMBER <sup>a</sup> NA				FISCAL YEAR		85	
C. TYPE				CURRENT		81	
D. KIND OF AWARD:				81		1.0	
E. AMOUNT:				81		97	
F. CUM. AMT.				81		97	
19. RESPONSIBLE DOD ORGANIZATION				20. PERFORMING ORGANIZATION			
NAME <sup>a</sup> US Army Institute of Dental Research				NAME <sup>a</sup> US Army Institute of Dental Research			
ADDRESS <sup>a</sup> Washington, DC 20012				Division of Pathology			
RESPONSIBLE INDIVIDUAL				ADDRESS <sup>a</sup> Washington, DC 20012			
NAME. Sweeney, T.P., COL, DC				PRINCIPAL INVESTIGATOR (Furnish SSAN if U.S. Academic Institution)			
TELEPHONE. 202-576-3484				NAME <sup>a</sup> Allen, G., MAJ, DC			
21. GENERAL USE				TELEPHONE 202-576-3443			
Foreign Intelligence Considered				SOCIAL SECURITY ACCOUNT NUMBER			
				ASSOCIATE INVESTIGATORS			
				NAME: Payne, T.F., LTC, DC			
				NAME:			
22. KEYWORDS (Precede EACH with Security Classification Code)							
(U) Spoon-Toothbrush (U) Oral Health (U) Dental Disease Prevention							
23. TECHNICAL OBJECTIVE, 24. APPROACH, 25. PROGRESS (Furnish individual paragraphs identified by number. Precede text of each with Security Classification Code.)							
23. (U) To develop new and simplified methods of preventing disease related dental emergencies in the field. To assess new methods of (1) improving the biologic management of militarily relevant oral conditions and (2) improving the cost-effectiveness factors of preventive dental therapy in the military.							
24. (U) Studies will be conducted on military installations which will evaluate (1) methods of prevention of military relevant abnormalities; (2) methods of improving preventive dentistry delivery systems, and (3) methods of improving cost-benefit ratios concerning delivery of preventive dentistry as a consequence of military duty.							
25. (U) (79 10 - 80 10) A prototype model of a spoon-toothbrush for incorporation in field rations has been produced. However, during field tests a structural flaw in the device necessitated suspension of testing and redesign of the toothbrush head. Redesign is now in progress and samples submitted to the US Army Natick Research and Development Command have been judged compatible with field ration packaging. Field testing will be resumed upon manufacture and delivery of the new toothbrush heads. Loss of the principal and associate investigators have necessitated temporary cessation of additional preventive dentistry studies.							

MILITARY RELEVANCY CERTIFIED UNDER  
SECTION 204 (FY FUNDS)  
BY *Samuel A. ...*

RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY				1. AGENCY ACCESSION <sup>a</sup>	2. DATE OF SUMMARY <sup>a</sup>	REPORT CONTROL SYMBOL	
				DA OF 6040	80 10 01	DD-DR&E(AR)636	
3. DATE PREV SUMRY	4. KIND OF SUMMARY	5. SUMMARY SCTY <sup>a</sup>	6. WORK SECURITY <sup>a</sup>	7. REGRADING <sup>a</sup>	8A. DDBN INSTN <sup>a</sup>	8B. SPECIFIC DATA CONTRACTOR ACCESS	9. LEVEL OF RUM
79 10 01	D. Change	U	U	NA	NI	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	A. WORK UNIT
10. NO. CODES <sup>a</sup>	PROGRAM ELEMENT	PROJECT NUMBER		TASK AREA NUMBER	WORK UNIT NUMBER		
6. PRIMARY	62775A	3S162775A825		AC	001		
<del>7. SECONDARY</del>	<del>62775A</del>	<del>3S162775A825</del>		<del>00</del>			
11. TITLE (Precede with Security Classification Code) <sup>a</sup> (U) Application of Laser Technology to Maxillofacial Wound Debridement and Prosthetic Rehabilitation							
12. SCIENTIFIC AND TECHNOLOGICAL AREAS <sup>a</sup>							
012900 Physiology 002400 Bioengineering							
13. START DATE		14. ESTIMATED COMPLETION DATE		15. FUNDING AGENCY		16. PERFORMANCE METHOD	
74 06		CONT		DA		C. IN-HOUSE	
17. CONTRACT/GRANT				18. RESOURCES ESTIMATE		19. PROFESSIONAL MAN YRS	
A. DATES/EFFECTIVE:				PRECEDING		B. FUNDS (in thousands)	
B. NUMBER <sup>a</sup>				FISCAL YEAR		80	
C. TYPE: NA				CURRENT		1.0	
D. KIND OF AWARD:				81		1.0	
E. CUM. AMT.						26	
19. RESPONSIBLE DOD ORGANIZATION				20. PERFORMING ORGANIZATION			
NAME <sup>a</sup> US Army Institute of Dental Research				NAME <sup>a</sup> US Army Institute of Dental Research			
ADDRESS <sup>a</sup> Washington, DC 20012				Division of Pathology			
				ADDRESS <sup>a</sup> Washington, DC 20012			
RESPONSIBLE INDIVIDUAL				PRINCIPAL INVESTIGATOR (Furnish SSAN if U.S. Academic Institution)			
NAME. Sweeney, T.P., COL, DC				NAME <sup>a</sup> Posey, W.R., COL, DC			
TELEPHONE: 202-576-3484				TELEPHONE: 202-576-3080			
21. GENERAL USE				SOCIAL SECURITY ACCOUNT NUMBER:			
Foreign Intelligence Considered				ASSOCIATE INVESTIGATORS			
				NAME: Allen, G., MAJ, DC			
				NAME:			
22. KEYWORDS (Precede EACH with Security Classification Code) <sup>a</sup> (U) Neodymium Laser (U) Carbon Dioxide Laser (U) Laser Welding (U) Periodontal Surgery (U) Prosthesis Repair							
23. TECHNICAL OBJECTIVE, 24. APPROACH, 25. PROGRESS (Furnish individual paragraphs identified by number. Precede text of each with Security Classification Code.)							
23. (U) To determine the feasibility of the application of laser technology to the repair of prostheses, oral surgical procedures and to the debridement and treatment of maxillofacial wounds.							
24. (U) Energy levels, methods of contour and approximation of pontics to establish optimum weld patterns and strengths will be investigated using neodymium laser. This will be accomplished first in a bench set-up and secondly in animals to establish feasibility and safety. The CO <sub>2</sub> laser will be used in periodontal defects in monkeys following periodontal surgery to determine its ability to improve the resolution of periodontal defects. Surgical debridement vs laser debridement of contaminated wounds will be done in animals.							
25. (U) (79 10 - 80 - 10) The CO <sub>2</sub> laser has been successfully applied in monkeys to the retardation of epithelial migration in periodontal defects following a new attachment attempt in periodontal surgery. It was hypothesized that retarding epithelial down-growth along the root surface would lead to greater amounts of connective tissue regeneration in the treated infrabony pockets. Preliminary analysis of subsequent histologic data indicates that use of the laser technique does result in increased connective tissue regeneration and improved resolution of the periodontal defects. Final analysis of histologic data on the use of the neodymium laser for <u>in vivo</u> repair of dental prosthesis placed in monkeys did not reveal any deleterious effects on dental pulp and surrounding oral tissues. The method is a rapid effective approach to prosthesis repair assuming that technical modifications can be made in the laser equipment to deliver energy in the mouth at various angles.							

DD FORM 1498

PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE. DD FORMS 1498-1, 1 MAR 68 (FOR ARMY USE) ARE OBSOLETE.

MILITARY RELEVANCY CERTIFIED AND FUNDS  
BY *[Signature]*

RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY				1. AGENCY ACCESSION <sup>a</sup>	2. DATE OF SUMMARY <sup>a</sup>	REPORT CONTROL SYMBOL DD-DR&E(AR)636	
3. DATE PREV SUMMARY <sup>a</sup>	4. KIND OF SUMMARY <sup>a</sup>	5. SUMMARY SCTY <sup>a</sup>	6. WORK SECURITY <sup>a</sup>	7. RESOURCES <sup>a</sup>	8. DESIG INSTR <sup>a</sup>	9. SPECIFIC DATA - CONTRACTOR ACCESS <sup>a</sup>	10. LEVEL OF SUM <sup>a</sup>
79 10 01	D. Change	U	U	NA	NL	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	A. WORK UNIT
10. NO./CODES <sup>a</sup>	PROGRAM ELEMENT		PROJECT NUMBER	TASK AREA NUMBER		WORK UNIT NUMBER	
1. PRIMARY	62775A	3S162775A825	AC	001			
2. SECONDARY	62775A	3S162775A825	00				
3. TERTIARY	STOG 80-7.2-5						
11. TITLE (Precede with Security Classification Code) <sup>a</sup> (U) Application of Laser Technology to Maxillofacial Wound Debridement and Prosthetic Rehabilitation							
12. SCIENTIFIC AND TECHNOLOGICAL AREAS <sup>a</sup> 012900 Physiology 002400 Bioengineering							
13. START DATE		14. ESTIMATED COMPLETION DATE		15. FUNDING AGENCY		16. PERFORMANCE METHOD	
74 06		CONT		DA		C. IN-HOUSE	
17. CONTRACT/GRANT				18. RESOURCES ESTIMATE		19. PROFESSIONAL MAN YRS	
a. DATES/EFFECTIVE:				PRECEDING			
b. NUMBER:				FISCAL YEAR		b. FUNDS (in thousands)	
c. TYPE: NA				80		1.0	
d. KIND OF AWARD:				81		1.0	
e. CUM. AMT.						65	
20. RESPONSIBLE DOD ORGANIZATION				21. PERFORMING ORGANIZATION			
NAME: US Army Institute of Dental Research				NAME: US Army Institute of Dental Research			
ADDRESS: Washington, DC 20012				ADDRESS: Washington, DC 20012			
RESPONSIBLE INDIVIDUAL				PRINCIPAL INVESTIGATOR (Pursue DEAN if U.S. Academic Institution)			
NAME: Sweeney, T.P., COL, DC				NAME: Posey, W.R., COL, DC			
TELEPHONE: 202-576-3484				TELEPHONE: 202-576-3080			
22. GENERAL USE				SOCIAL SECURITY ACCOUNT NUMBER:			
Foreign Intelligence Considered				ASSOCIATE INVESTIGATORS			
				NAME: Allen, G., MAJ, DC			
				NAME:			
23. KEYWORDS (Precede EACH with Security Classification Code) <sup>a</sup> (U) Neodymium Laser (U) Carbon Dioxide Laser (U) Laser Welding (U) Periodontal Surgery (U) Prosthesis Repair							
24. TECHNICAL OBJECTIVE, 25. APPROACH, 26. PROGRESS (Pursue individual paragraphs identified by number. Precede text of each with Security Classification Code.)							
23. (U) To determine the feasibility of the application of laser technology to the repair of prostheses, oral surgical procedures and to the debridement and treatment of maxillofacial wounds.							
24. (U) Energy levels, methods of contour and approximation of pontics to establish optimum weld patterns and strengths will be investigated using neodymium laser. This will be accomplished first in a bench set-up and secondly in animals to establish feasibility and safety. The CO <sub>2</sub> laser will be used in periodontal defects in monkeys following periodontal surgery to determine its ability to improve the resolution of periodontal defects. Surgical debridement vs laser debridement of contaminated wounds will be done in animals.							
25. (U) (79 10 - 80 - 10) The CO <sub>2</sub> laser has been successfully applied in monkeys to the retardation of epithelial migration in periodontal defects following a new attachment attempt in periodontal surgery. It was hypothesized that retarding epithelial down-growth along the root surface would lead to greater amounts of connective tissue regeneration in the treated infrabony pockets. Preliminary analysis of subsequent histologic data indicates that use of the laser technique does result in increased connective tissue regeneration and improved resolution of the periodontal defects. Final analysis of histologic data on the use of the neodymium laser for <u>in vivo</u> repair of dental prosthesis placed in monkeys did not reveal any deleterious effects on dental pulp and surrounding oral tissues. The method is a rapid effective approach to prosthesis repair assuming that technical modifications can be made in the laser equipment to deliver energy in the mouth at various angles.							

DD FORM 1498

PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE. DD FORMS 1498-1, 1 MAR 66 (FOR ARMY USE) ARE OBSOLETE.

MILITARY RELEVANCY CERTIFIED UNCLASSIFIED  
FUNDING  
BY: [Signature]

RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY				1. AGENCY ACCESSION <sup>a</sup>	2. DATE OF SUMMARY <sup>a</sup>	REPORT CONTROL SYMBOL DD-DR&E(AR)636	
3. DATE PREV SUMMARY	4. KIND OF SUMMARY	5. SUMMARY SCTY <sup>a</sup>	6. WORK SECURITY <sup>a</sup>	7. REGRADING <sup>a</sup>	8A. DISSEM INSTR <sup>a</sup>	8B. SPECIFIC DATA - CONTRACTOR ACCESS	9. LEVEL OF SUM
79 10 01	D. Change	U	U	NA	NL	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	A. WORK UNIT
10. NO./CODES <sup>a</sup>	PROGRAM ELEMENT	PROJECT NUMBER		TASK AREA NUMBER		WORK UNIT NUMBER	
a. PRIMARY	62775A	3S162775A825		AC		002	
b. <del>Contracting</del>	62775A	3S162775A825		00			
c. <del>Contracting</del>	STOG 80-7.2:5						
11. TITLE (Precede with Security Classification Code) <sup>a</sup>							
(U) Development and Evaluation of Dental Materials and Materiel for Army Use							
12. SCIENTIFIC AND TECHNOLOGICAL AREAS <sup>a</sup>							
010300 Miscellaneous Materials							
13. START DATE		14. ESTIMATED COMPLETION DATE		15. FUNDING AGENCY		16. PERFORMANCE METHOD	
69 01		CONT		DA		C. IN-HOUSE	
17. CONTRACT/GRANT				18. RESOURCES ESTIMATE		19. PROFESSIONAL MAN YRS	
a. DATES/EFFECTIVE:				PRECEDING		b. FUNDS (in thousands)	
b. NUMBER: NA				FISCAL YEAR		80	
c. TYPE:				CURRENT		2.0	
d. KIND OF AWARD:				81		2.0	
e. CUM. AMT.				120			
20. RESPONSIBLE OGD ORGANIZATION				20. PERFORMING ORGANIZATION			
NAME: US Army Institute of Dental Research				NAME: US Army Institute of Dental Research			
ADDRESS: Washington, DC 20012				ADDRESS: Division of Dental Materials			
RESPONSIBLE INDIVIDUAL				PRINCIPAL INVESTIGATOR (Furnish SSAN if U.S. Academic Institution)			
NAME: Sweeney, T.P., COL, DC				NAME: Huget, E.F., COL, DC			
TELEPHONE: 202-576-3484				TELEPHONE: 202-576-3092			
21. GENERAL USE				SOCIAL SECURITY ACCOUNT NUMBER:			
Foreign Intelligence Considered				ASSOCIATE INVESTIGATORS			
				NAME: Vermilyea, S., LTC, DC			
				NAME: Kuffler, M., B.S.			
22. KEYWORDS (Precede EACH with Security Classification Code) (U) Silver-Laden Alloys (U) Nickel-Based Alloy							
(U) Low-Gold Alloys (U) Ni-Be Free Alloy (U) Adhesive Composite (U) Denture Cleansing							
23. TECHNICAL OBJECTIVE, 24. APPROACH, 25. PROGRESS (Furnish individual paragraphs identified by number. Precede text of each with Security Classification Code.)							
<p>23. (U) To evaluate new materials and materiel of special interest to the Army dentist. Criteria for selection of materials, devices or techniques for evaluation are based on anticipated high potentials for: (1) Savings of fiscal and/or manpower resources; (2) work simplification; (3) improved health care delivery in combat areas; and (4) enhanced safety with respect to professional and ancillary personnel as well as to the patient.</p> <p>24. (U) New materials will be evaluated on the basis of the following parameters: Composition, microstructure, physical and mechanical properties, cytotoxicity, and clinical performance.</p> <p>25. (U) (79 10 - 80 10) Two less-expensive alternates to high-fusing silver-laden crown and bridge alloys (Ceramate and Eclipse) were found to perform as well as products currently used by the Army. A new nickel-based casting alloy (Unibond) was not found, as claimed to be superior to other available base-metal casting alloys. Clinical evaluation of 3 low-gold casting alloys (Midas, Neycast and Minigold) demonstrated persistent pitting and discoloration of the cervical margins of full crown restorations at 20 months post-placement. Two new nickel-free, beryllium-free casting alloys were evaluated and found acceptable for Army use. Evaluation of a new, contractor-developed, adhesive restorative did not corroborate the contractors data. Incorrect specimen preparation by the contractor resulted in spurious data. New specimens are being prepared. A study of 5 proprietary denture cleansers indicated that all were deleterious to partial denture framework.</p>							
<p>MILITARY RELEVANCY CERTIFIED UNDER SECTION 204 (FY FUNDS)</p> <p>BY: <i>Howard G. B...</i></p>							

PROJECT NUMBER 3S162775A825

DEVELOPMENT AND EVALUATION OF DENTAL MATERIALS  
AND MATERIAL FOR ARMY USE

Assessment of Alternatives to High Fusing Silver-Laden Crown and  
Bridge Alloys.

The interaction of oxides of silver with dental porcelain as a cause of undesirable discoloration of the ceramic component of porcelain metal restorations is well known. It has been suggested that alloys of the gold-palladium system without silver may be relatively low cost alternatives to the expensive gold-platinum-palladium alloys and would eliminate silver oxide discoloration of porcelain. Accordingly, the structural features, mechanical properties and handling characteristics of two gold-palladium based alloys (Cermate, J. Aderer, Inc. and Eclipse, J. M. Ney Co.) have been determined. As cast properties of Cermate were: UTS, 78,000 psi; YS, 60,000; EL, 41,000 psi; E  $17 \times 10^6$  psi; El 9% and H 212 (DPN) where as those measured for Eclipse specimens in the as cast condition were: UTS, 102,000 psi; YS, 72,000 psi; EL, 49,000 psi; E,  $18 \times 10^6$  psi; El 9%. Subjecting cast discs of each material to a simulated porcelain firing cycle elicited decreases in hardness of 21% and 12% for Cermate and Eclipse respectively. Subjective assessment of handling characteristics are not supportive of manufacturers' claims for superiority of color and esthetics of porcelain-metal prosthesis fabricated from silver-free casting alloys. However, the performance capabilities of Cermate and Eclipse are comparable to those of silver-containing products used routinely in military dental practice. Compositional analysis remains to be accomplished.

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### Characterization of a Nickel-Based Dental Casting Alloy

Mechanical properties, compositions and structural features of an aggressively marketed nickel based casting alloy (Unibond, Unitek Corp) have been determined. As cast properties were: UTS, 86,000 psi; YS, 48,000 psi; EL 31,000 psi; E,  $28 \times 10^6$  psi; El 20% and H 205 (Vickers DPN). Heat treatment of cast specimens by a simulated porcelain firing cycle did not alter the mechanical properties. Analysis showed that the material was a binary nickel-chromium alloy (Ni 67% and Cr 19.5%). Minor components of Unibond were: Mo (~11%), Fe (~2%), Si (0.45%), and Mn (0.37%). Metallographic examination revealed fields of coarse dendritic intragranular precipitates.

The results are in keeping with those obtained from numerous other inexpensive base metal casting alloys.

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### Clinical Evaluation of "Low Gold" Casting Alloys

This task, initiated in January 1979, is designed to assess the *in vivo* performance capability of three economy dental casting alloys (gold content 50 percent by weight). The test materials are Midas (J.F. Jelenko), Neycast (J.M. Ney) and Minigold (Williams' Gold Refining Co.). The pitting and discoloration of the cervical margins of full crown restorations fabricated from these alloys remains persistent at the 20th month post-placement evaluation. These observations are consistent with *in vitro* findings on the electrochemical behavior of the test alloys.

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## Evaluation of Nickel Free-Beryllium Free Casting Alloys

Nickel and beryllium have been major and minor constituents respectively for a variety of castable dental and medical alloys. The potential allergenic and carcinogenic hazards of these materials have been widely recognized and documented. In recent months, alloys devoid of the aforementioned components have become available. Two such alloys (Neobond II, Neoloy, Inc, and Biocast, Rx Jeneric Co.) have been examined with respect to mechanical properties, heat treatment characteristics and microstructure. As cast properties of the test alloys differed only with respect to elastic limit, percent elongation and hardness. As cast values for Neobond II were EL 67,000 psi, El 3% and DPH 290 whereas those observed for Biocast were El 37,000 psi; El 1% and DPH 390. Mean values for the other as cast properties were UTS 103,000 psi; YS, 80,000 psi and E 30X10<sup>6</sup> psi. Exposure of Neobond II to a simulated porcelain firing cycle elicited a 19% increase in hardness and a 76 percent decrease in elongation. Biocast exhibited a 9 percent increase in hardness subsequent to the heat treatment cycle. As cast microstructures demonstrated microsegregation and a discontinuous grain boundary phase. Alteration of microstructural characteristics was not a striking feature of Biocast. However, Neobond II exhibited the formation of a crystallographically dependent acicular precipitate subsequent to the porcelain firing cycle. The latter features are consistent with the dramatic reduction in elongation and the increase in hardness exhibited by this alloy when heat treated. The handling characteristics of Neobond II and Biocast are similar to those of their more common nickel-chromium based counterparts. Electrochemical (corrosion) profiles of these alloys remain to be determined.

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## Evaluation of a Recently Developed Adhesive Dental Restorative Material

A new (March 1980) polymeric composition of matter developed as a dental adhesive under the terms of our extramural contract research program was subjected to laboratory evaluation. Our findings did not substantiate the data submitted by the contractor (Dr M. Dichter, Polymer Research Corporation of America). Furthermore, examination of composite restorative-bovine tooth couples prepared by the contractor revealed the following: (1) inability of the contract-investigator to distinguish enamel and dentin; (2) violation of experimental protocol by the creation of a retentive area (hole) on the surface of the substrate-adherend (tooth) by mechanical means; (3) failure of the contractor to recognize that his "bond strength" test couple rather than adhesive-adherend strength. This new development is not acceptable for use in military dental practice.

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## Base Metal-Denture Cleanser Compatibility

The daily cleansing of removable dental prostheses is an important facet of oral health maintenance for edentulous and partially edentulous patients. Although a vast spectrum of cleansing procedures can be employed for the removal of acquired stains and deposits from polymeric and metallic dentures, most patients express preference for the exclusive use of immersion type cleansers. In response to numerous questions from dental officers as to the effect of denture cleansers on the metallic components of removable prostheses, a study was initiated to assess the relative abilities of six proprietary denture cleansers to cause dissolution of aluminum, cobalt-chromium (Vitalium<sup>2</sup>),



nickel chromium (Ticonium) and cobalt-nickel chromium (Durallium LG) denture framework alloys. Potentio-dynamic polarization techniques as well as open-circuit potential measurements were made on each alloy immersed in each of five proprietary denture cleansers. Under the conditions of the study, only one alloy (Ticonium) exhibited the ability to passivate (i.e., form a protective film) when immersed in the cleansers. The findings contraindicate the use of five widely used denture cleansers (Mersene, Polident, 4-Minute, Efferdent and Calgon-Chlorox solution) for the immersion-cleansing of cobalt-based removable partial denture frameworks. Furthermore, the frequent rinsing of removable appliances in water and their occasional cleansing in mild detergents are practical alternatives to the habitual use of denture cleansers.

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Publications:

1. Vermilyea, S.G., Modawar, F.A., and Huget, E.F. Laboratory Evaluation of Crown and Bridge Temporary Resins. *Milit Med* 145(5):343-344, May 1980.
2. Vermilyea, S.G., Huget, E.F., and de Simon, L.B. Apparent Viscosities of Setting Elastomers. *J Dent Res* 59:1149-1151, July 1980.
3. Lorton, L., Moore, B.K., Swartz, M.L., and Phillips, R.W. Rheology of Luting Cements. *J Dent Res* 59(9):1486-1492, Sep 1980.
4. Cutright, D.E., Huget, E.F., and Brady, J.M. Asbestos: A Subtle Carcinogen in the Dental Laboratory. *General Dent* 28:46, May-June 1980.
5. Huget, E.F., Vermilyea, S.G., and Modawar, F.A. Partial Denture Alloy-Denture Cleanser Interaction. *Milit Med* (in press).
6. Huget, E.F., Vermilyea, S.G., and de Simon, L.B. Viscoelastic Behavior of High Copper Dental Amalgam Alloys. *Milit Med* (in press).
7. Huget, E.F., Vermilyea, S.G., Fehrman, S.G., and Modawar, F.A. Laboratory Observations on the Behavior of Composite Dental Restoratives. *Milit Med* (in press).
8. Huget, E.F., Vermilyea, S.G., Modawar, F.A., and Tamura, J.J. Electrochemical Profiles of Crown-and-Bridge Alloys. *Milit Med* (in press).
9. Huget, E.F., Vermilyea, S.G., Modawar, F.A., and de Simon, L.B. Electrochemical Behavior of Gold Alloys. *Milit Med* (in press).
10. Huget, E.F., Vermilyea, S.G., and Modawar, F.A. Partial Denture Alloy-Denture Alloy-Denture Cleanser Interaction. *Milit Med* (in press).

RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY				1. AGENCY ACCESSION <sup>a</sup>	2. DATE OF SUMMARY <sup>a</sup>	REPORT CONTROL SYMBOL DD-DR&E(AR)636	
3. DATE PREV. SUMMARY	4. KIND OF SUMMARY	5. SUMMARY SCTY <sup>a</sup>	6. WORK SECURITY <sup>a</sup>	7. REGRADING <sup>a</sup>	8A. DISEN INSTR <sup>a</sup>	8B. SPECIFIC DATA - CONTRACTOR ACCESS	9. LEVEL OF SUM <sup>a</sup>
79 10 01	D. Change	U	U	NA	NL	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	A. WORK UNIT
10. NO. / CODES <sup>a</sup>	PROGRAM ELEMENT	PROJECT NUMBER		TASK AREA NUMBER		WORK UNIT NUMBER	
A. PRIMARY	62775A	3S162775A825		AB		003	
B. <del>SECONDARY</del>	62775A	3S162775A825		00			
C. <del>THIRDARY</del>	STOG 80-7.2:5						
11. TITLE (Precede with Security Classification Code) <sup>a</sup>							
(U) Development and Improvement of Metallic Restorative Materials							
12. SCIENTIFIC AND TECHNOLOGICAL AREAS <sup>a</sup>							
00 9900 Metallurgy and Metallography							
13. START DATE		14. ESTIMATED COMPLETION DATE		15. FUNDING AGENCY		16. PERFORMANCE METHOD	
69 01		CONT		DA		C. IN-HOUSE	
17. CONTRACT/GRANT				18. RESOURCES ESTIMATE		19. PROFESSIONAL MAN YRS	
A. DATES/EFFECTIVE:		EXPIRATION:		PRECEDING			
B. NUMBER <sup>a</sup>		C. TYPE		FISCAL YEAR		FUND (in thousands)	
NA		4. AMOUNT:		CURRENT		70	
6. KIND OF AWARD:		7. CUM. AMT.		81		1.0	
						30	
19. RESPONSIBLE OOD ORGANIZATION				20. PERFORMING ORGANIZATION			
NAME: US Army Institute of Dental Research				NAME: US Army Institute of Dental Research			
ADDRESS: Washington, DC 20012				ADDRESS: Washington, DC 20012			
RESPONSIBLE INDIVIDUAL				PRINCIPAL INVESTIGATOR (Furnish SSAN if U.S. Academic Institution)			
NAME: Sweeney, T.P., COL, DC				NAME: Huget, E.F., COL, DC			
TELEPHONE: 202-576-3484				TELEPHONE: 202-576-3092			
21. GENERAL USE				SOCIAL SECURITY ACCOUNT NUMBER:			
Foreign Intelligence Considered				ASSOCIATE INVESTIGATORS			
				NAME: Vermilyea, S., LTC, DC			
				NAME:			
22. KEYWORDS (Precede EACH with Security Classification Code) (U) Casting Accuracy (U) Base Metal Restorations							
(U) Base Metal Casting (U) Investment Material (U) Ceramigold II (U) High-Temp							
23. TECHNICAL OBJECTIVE, 24. APPROACH, 25. PROGRESS (Furnish individual paragraphs identified by number. Precede text of each with Security Classification Code.)							
<p>23. (U) Annual Army expenditures for precious metals utilized in the fabrication of fixed dental prostheses are in the vicinity of \$1,000,000. The cost of an equal volume of base metal alloy is \$30,000. Properties of base metal alloys indicates however that these alloys cannot be utilized for small castings without drastic metallurgical modifications. This work is therefore being conducted to: (a) Develop heat treatment methods for controlling properties of nickel-chromium based casting alloys; (b) evaluate nickel-chromium based alloys for use in operative dentistry.</p> <p>24. (U) The properties of nickel-chromium based alloys will be studied in detail by various physical methods available in order to devise procedures which will optimize their usefulness. Any improvement obtained will be evaluated clinically.</p> <p>25. (U) (79 10 - 80 10) Studies on the influence of investment materials on the fit of base metal restorations indicated that modification of investing and casting techniques could enhance the fit of cast base metal restorations. Presently, the poor casting characteristics of the base metal alloys evaluated tend to limit their range of application in military dental practice. Only 8% of the castings made were found to be adequate.</p>							

MILITARY RELEVANCY CERTIFIED UNDER  
SECTION 201 (FY FUNDS)  
BY *[Signature]*

DD FORM 1498  
1 MAR 68

PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE DD FORMS 1498A, 1 NOV 65  
AND 1498-1, 1 MAR 68 (FOR ARMY USE) ARE OBSOLETE.

PROJECT NUMBER 3S162775A825

DEVELOPMENT AND IMPROVEMENT OF METALLIC RESTORATIVE MATERIALS

Improvement of the Casting Accuracy of Crown and Bridge Alloys.

This work assessed the influence of investment material on the fit of base metal restorations. The investments (Ceramigold II, Whip-Mix Corp; High-Temp, Whip-Mix Corp, and Neoloy Products, Inc) are marketed for use with base metal casting alloys. Seventy-five wax patterns were made on individual stone dies and an equal number invested in each material. A like number of molds was cast in Biobond, Ceramalloy II, Unibond, Biocast and Neobond II. An additional five wax patterns were invested in each material and cast in a gold-palladium alloy (Olympia) to monitor investing and casting technique. The castings were retrieved from their molds, seated on their respective dies, and examined under low power magnification for assessment of marginal integrity and fit. Castings were judged as adequate (x); oversize (+), or undersize (-). As a group, the test castings failed to fit their respective dies. The distribution of the scores for the total sample were: (x) 8%; (+) 23%, and (-) 69%. Base-metal castings fabricated from Neoloy investment molds were consistently undersize as were 80% of those cast in the gold-palladium alloy, Olympia. On the other hand, 80% of the Olympia castings from High-Temp and Ceramigold II were judged as adequate and 20% were judged oversize. With Ceramigold II, castings of Biobond and Ceramalloy II were oversize. Rounded, ill-defined margins were a characteristic feature of the base metal castings. The poor casting characteristics tend to limit the range of application of Biobond, Unibond, Biocast, Ceramalloy II and Neobond II in military dental practice. The findings suggest that modification of investing and casting techniques may enhance the fit of cast base metal restorations.

Publications:

1. Huget, E.F., Vermilyea, S.G., and Vilca, J.M. Studies on White Crown and Bridge Alloys. Milit Med 144:(12):909-810, Dec 1979.
2. Huget, E.F., Vermilyea, S.G., de Simon, L.B., and Modawar, F.A. Electro-mechanical Behavior of Surgical Alloys. Milit Med 145(5):340-342, May 1980.
3. Vermilyea, S.G., Huget, E.F., and Vilca, J.M. Observations on Gold-Palladium-Silver and Gold-Palladium Alloys. J Prosthet Dent 44(3):294-299, Sep 1980.
4. Huget, E.F., Vermilyea, S.G., and Kuffler, M.J. Accuracy of Small Base Metal Dental Castings. Milit Med (in press)
5. Huget, E.F., Vermilyea, S.G., and Vilca, J.M. Low Gold Crown and Bridge Alloys. Milit Med (in press).

RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY				1. AGENCY ACCESSION <sup>a</sup>	2. DATE OF SUMMARY <sup>a</sup>	REPORT CONTROL SYMBOL DD-DR&E(AR)636	
3. DATE PREV. SUMMARY	4. KIND OF SUMMARY	5. SUMMARY SCTY <sup>a</sup>	6. WORK SECURITY <sup>a</sup>	7. REGRADING <sup>a</sup>	8. DISSEM INSTR <sup>a</sup>	9a. SPECIFIC DATA - CONTRACTOR ACCESS	9. LEVEL OF SUM
79 10 01	D. Change	U	U	NA	NL	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	A. WORK UNIT
10. NO. CODES <sup>a</sup>	PROGRAM ELEMENT	PROJECT NUMBER	TASK ARFA NUMBER	WORK UNIT NUMBER			
A. PRIMARY	62775A	3S162775A825	AD	004			
B. SECONDARY	62775A	3S162775A825	00				
11. TITLE (Precede with Security Classification Code) <sup>a</sup>							
(U) Natural History of Oral Lesions Encountered in The Soldier							
12. SCIENTIFIC AND TECHNOLOGICAL AREAS <sup>a</sup>							
012900 Physiology							
13. START DATE		14. ESTIMATED COMPLETION DATE		15. FUNDING AGENCY		16. PERFORMANCE METHOD	
69 07		CONT		DA		C. IN-HOUSE	
17. CONTRACT/GRANT				18. RESOURCES ESTIMATE		19. PROFESSIONAL MAN YRS	
A. DATES/EFFECTIVE:				B. PRECEDING		C. FUNDS (in thousands)	
D. NUMBER <sup>a</sup> NA				FISCAL YEAR		50	
E. TYPE				CURRENT		25	
F. KIND OF AWARD				81		0.5	
19. RESPONSIBLE DOD ORGANIZATION				20. PERFORMING ORGANIZATION			
NAME <sup>a</sup> US Army Institute of Dental Research				NAME <sup>a</sup> US Army Institute of Dental Research			
ADDRESS <sup>a</sup> Washington, DC 20012				Division of Pathology			
RESPONSIBLE INDIVIDUAL				PRINCIPAL INVESTIGATOR (Furnish SSAN if U.S. Academic Institution)			
NAME: Sweeney, T.P., COL, DC				NAME <sup>a</sup> Posey, W., COL, DC			
TELEPHONE: 202-576-3484				TELEPHONE: 202-576-3080			
21. GENERAL USE				SOCIAL SECURITY ACCOUNT NUMBER:			
Foreign Intelligence Considered				ASSOCIATE INVESTIGATORS			
				NAME: Carpenter, W., COL, DC			
				NAME:			
22. KEYWORDS (Precede EACH with Security Classification Code) <sup>a</sup>							
(U) Lip Pathology (U) Lip Ointment (U) Malposed Incisors							
(U) Climate Extremes							
23. TECHNICAL OBJECTIVE <sup>a</sup> , 24. APPROACH, 25. PROGRESS (Furnish individual paragraphs identified by number. Precede text of each with Security Classification Code.)							
<p>23. (U) To recognize, characterize and develop effective therapeutic measures for those lesions and conditions which affect the soldier due to military duty. The recognition of environmental and other factors which participate in the etiology of lesions and conditions unique to the military or are casually related to military duty will enable the development of interceptive or therapeutic measures.</p> <p>24. (U) To detect through clinical and/or microscopic observation oral lesions or a condition unique to the military population. To identify oral lesions or conditions which, though not unique to the soldier, are etiologically related to the performance of duty. Once identified the natural history including etiology, therapy, and prognosis will be established utilizing appropriate methods such as surveys, animal, and human investigations.</p> <p>25. (U) (79 10 - 80 10) An epidemiological survey of lip pathology among 800 soldiers was completed during cold weather exercises at Ft Drum, New York, in January 1980. Unseasonably warm weather did not provide appropriate conditions for the study. Lip lesions were seen in 1% of the troops. The study will be repeated. In addition, a fresh commercial preparation of lip ointment will be compared with a similar preparation in Army supply channels to determine if storage stability is a problem. A study on the relation of malposed incisors to periodontal destruction did not reveal a significant correlation between them.</p>							

MILITARY RELEVANCY CERTIFIED UNDER  
 SECTION 20, AFY  
 BY: *[Signature]* A. Schiefel

DD FORM 1498  
 1 MAR 68

PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE. DD FORMS 1498A 1 NOV 68 AND 1498-1 1 MAR 68 (FOR ARMY USE) ARE OBSOLETE

RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY				1. AGENCY ACCESSION <sup>a</sup>	2. DATE OF SUMMARY <sup>a</sup>	REPORT CONTROL SYMBOL	
				DA OH 6037	80 10 01	DD-DR&E(AR)636	
3. DATE PREV SUMMARY	4. KIND OF SUMMARY	5. SUMMARY SCTY <sup>a</sup>	6. WORK SECURITY <sup>a</sup>	7. REGRADING <sup>a</sup>	8. DDD'S MSTRN <sup>a</sup>	9. SPECIFIC DATA - CONTRACTOR ACCESS <sup>a</sup>	10. LEVEL OF BUS <sup>a</sup>
79 10 01	D. Change	U	U	NA	NL	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	A. WORK UNIT
10. NO./CODES: <sup>a</sup>		PROGRAM ELEMENT		PROJECT NUMBER		TASK AREA NUMBER	
						WORK UNIT NUMBER	
a. PRIMARY		62775A		3S162775A825		AA 007	
b. CONTINGENT/STOG		62775A		3S162775A825		00	
c. CONTINGENT/STOG		80-7.2:5					
11. TITLE (Precede with Security Classification Code) <sup>a</sup>							
(U) New and Improved Techniques for Grafts and Bone Regeneration in Traumatic Wounds							
12. SCIENTIFIC AND TECHNOLOGICAL AREAS <sup>a</sup>							
012900 Physiology 002400 Bioengineering							
13. START DATE		14. ESTIMATED COMPLETION DATE		15. FUNDING AGENCY		16. PERFORMANCE METHOD	
69 01		CONT		DA		C. IN-HOUSE	
17. CONTRACT/GRANT				18. RESOURCES ESTIMATE		19. PROFESSIONAL MAN YRS	
a. DATES/EFFECTIVE:				PRECEDING		b. FUNDS (In thousands)	
d. NUMBER: <sup>a</sup> NA				FISCAL YEAR		80 2.0 75	
c. TYPE:				CURRENCY		81 2.0 55	
e. KIND OF AWARD:				f. CUM. AMT.			
19. RESPONSIBLE DOD ORGANIZATION				20. PERFORMING ORGANIZATION			
NAME: <sup>a</sup> US Army Institute of Dental Research				NAME: <sup>a</sup> US Army Institute of Dental Research			
ADDRESS: <sup>a</sup> Washington, DC 20012				ADDRESS: <sup>a</sup> Washington, DC 20012			
RESPONSIBLE INDIVIDUAL				PRINCIPAL INVESTIGATOR (Furnish SSAN if U.S. Academic Institution)			
NAME: Sweeney, T.P., COL, DC				NAME: <sup>a</sup> Tortorelli, A., COL, DC			
TELEPHONE: 202-576-3484				TELEPHONE: 202-576-3778			
21. GENERAL USE				SOCIAL SECURITY ACCOUNT NUMBER:			
Foreign Intelligence Considered				ASSOCIATE INVESTIGATORS			
				NAME: Snyder, A., COL, DC			
				NAME: Cutright, D.E., COL, DC			
22. KEYWORDS (Precede EACH with Security Classification Code) (U) Biodegradable Ceramic (U) Biodegradable Splint (U) Osteogenic Agents (U) Granular Ceramic Implant (U) Periodontal Defects							
23. TECHNICAL OBJECTIVE, <sup>a</sup> 24. APPROACH, 25. PROGRESS (Furnish individual paragraphs identified by number. Precede text of each with Security Classification Code.)							
<p>23. (U) Current methodologies for managing combat maxillofacial wounds and preventing/treating dental emergencies in the field will be extremely difficult to apply under the conditions anticipated in future war. New methods are required which will permit more rapid definitive care, reduce morbidity and decrease logistic load. Thus the objective of this work unit is to develop simple, rapid methods for soft tissue or bone grafting utilizable by the dental specialist in the field.</p> <p>24. (U) The fate, metabolism, osteogenic potential and tissue compatibility of ceramic and copolymer materials will be studied alone and in combination. The application of these and other materials to avulsive type wounds in both animals and humans will be pursued.</p> <p>25. (U) (79 10 - 80 10) A partly biodegradable device for splinting discontinuity defects and holding osteogenic agents within the discontinuity has been successfully tested in dogs. A specially designed biodegradable ceramic block has also been successfully applied in bridging mandibular defects in dogs. The basis of the design was the incorporation of enlarged and unidirectional porosity in the ceramic to facilitate tissue ingrowth. An improved design for enhanced tissue ingrowth and biodegradation is being constructed. To date 51 patients have received granular biodegradable ceramic implantation in periodontal defects. Eighteen month reentries in 12 patients have demonstrated significant improvements in pocket depth, periodontal attachment levels and bone regeneration.</p>							

<sup>a</sup>Available to contractors upon originator's approval.

DD FORM 1498  
1 MAR 68

PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE. DD FORMS 1498A, 1 NOV 65 AND 1498-1, 1 MAR 68 (FOR ARMY USE) ARE OBSOLETE.

MILITARY RELEVANCY CERTIFIED UNDER  
SECTION 204 (FY FUNDS)  
BY: *[Signature]*

PROJECT NUMBER 3S162775A825

NEW AND IMPROVED TECHNIQUES FOR GRAFTS AND  
BONE REGENERATION IN TRAUMATIC WOUNDS

Evaluation of a Partly Biodegradable and Partly Biocompatible Tray  
for Bone Grafting in the Dog Mandible.

Three trays or cribs supplied under contract were inserted into the right mandible of three mongrel dogs in combination with autologous bone and marrow. The trays were essentially of two types; two consisting of laminated polymer and ceramic plates connected around the inferior border with a purely polymer sheet and one consisting of a molded and annealed laminated plate of the same materials.

The object of this phase of the study was to determine whether these trays were strong enough over time to support a mandible with a continuity defect while in junction and to determine whether there is significant biodegradation or resorption of the biodegradable portion of the tray material.

Metal screws were used to fix the trays to the mandible; polymer screws were not available with sufficient strength to fix the stumps in a functioning animal. In fact, evidence suggests that it probably is not possible to fabricate a polymer screw (biodegradable) with enough strength in itself to provide rigid fixation over a continuity defect. The mandible would have to be immobilized by other means (i.e., intermaxillary fixation, external pin fixation) in addition to placement of the tray. This would preclude function while consolidation of the defect took place.

It was noted, however, that in the areas accessible intraorally, these metal screws could be removed through very small stab incisions intraorally under local anesthesia very simply and quickly and without significant morbidity.



Following placement of the trays, the mandibles were manipulated and x-rays were taken at set intervals to determine the degree of stabilization. All three mandibles remained stable throughout without significant movement between proximal and distal ends.

The dogs were sacrificed at 6, 8, and 12 weeks. Gross examination revealed the bulk of the laminated material to be still present. The material would not soften in decalcifying solution and, therefore, histologic sections of the trays themselves could not be made. Histologic evaluation of the bone graft placed in the trays showed healing commensurate with post-operative time. Soft tissue and bone immediately adjacent to the implanted material showed little or no inflammatory reaction.

The annealed tray showed no signs of rebound or return to its original shape by virtue of elastic memory phenomenon.

Results indicate that these trays, when fixed with metal screws, are strong enough to support a mandible with a continuity defect over a period of up to 12 weeks. Complete healing and filling in of the defect with bone occurred without additional mandibular immobilization methods.

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Evaluation of a Biodegradable Unidirectional Porosity  
Ceramic Block for Bridging a Bony Defect with Mandible  
of Dogs.

Five mongrel dogs were operated from February through May 1980. A two centimeter portion of the mandible was resected along with its periosteum. A 2x1½ cm block of tricalcium phosphate ceramic was wired into place between the proximal and distal bony stumps and a metal bone plate was used to stabilize

the mandible. The ceramic block contained cylindrical porosities averaging 250 microns in diameter arranged in the direction of desired bone growth. These were spaced uniformly and were in addition to naphthalene crystal voids with a maximum diameter of 350 microns. The animals were sacrificed at 2, 6, 8, 12, and 24 weeks. Decalcified sections were made of representative portions of each specimen. Ground sections were prepared of the 24 week specimen. Evaluations are currently being made.

It is apparent from work completed thus far that ingrowth of connective tissue and formation of new bone within the ceramic is enhanced by the presence of the unidirectional porosities. Most of the ceramic remained after 24 weeks *in vivo* and it can be postulated that this form of tricalcium phosphate takes a long time to be resorbed.

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RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY				1. AGENCY ACCESSION <sup>a</sup>	2. DATE OF SUMMARY <sup>a</sup>	REPORT CONTROL SYMBOL	
				DA OH 6038	80 10 01	DD-DR&E(AR)636	
3. DATE PREV SUMMARY	4. KIND OF SUMMARY	5. SUMMARY SCTY <sup>a</sup>	6. WORK SECURITY	7. REGRADING <sup>a</sup>	8. DUE IN INSTN <sup>a</sup>	9. SPECIFIC DATA- CONTRACTOR ACCESS	10. LEVEL OF SUM
79 10 01	D. Change	U	U	NA	NL	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	A. WORK UNIT
10. NO./CODES <sup>a</sup>	PROGRAM ELEMENT	PROJECT NUMBER		TASK AREA NUMBER		WORK UNIT NUMBER	
a. PRIMARY	62775A	3S162775A825		AB		006	
b. <del>62775A</del>	62775A	3S162775A825		00			
c. <del>62775A</del>	STOG 80-7.2:5						
11. TITLE (Precede with Security Classification Code) <sup>a</sup>							
(U) Development of Endodontic Procedures for Military Dentistry							
12. SCIENTIFIC AND TECHNOLOGICAL AREAS <sup>a</sup>							
002400 Bioengineering							
13. START DATE		14. ESTIMATED COMPLETION DATE		15. FUNDING AGENCY		16. PERFORMANCE METHOD	
68 07		CONT		DA			
17. CONTRACT/GRANT				18. RESOURCES ESTIMATE		19. PROFESSIONAL MAN YRS	
a. DATES/EFFECTIVE:				PRECEDING		b. FUND (in thousands)	
b. NUMBER <sup>a</sup>				FISCAL YEAR		c. FUND (in thousands)	
c. TYPE:				80		2.0	
d. KIND OF AWARD:				81		0.5	
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f. CUM. AMT.							
20. RESPONSIBLE DOD ORGANIZATION				21. PERFORMING ORGANIZATION			
NAME <sup>a</sup> US Army Institute of Dental Research				NAME <sup>a</sup> US Army Institute of Dental Research			
ADDRESS <sup>a</sup> Washington, DC 20012				Division of Oral Biology			
RESPONSIBLE INDIVIDUAL				ADDRESS <sup>a</sup> Washington, DC 20012			
NAME: Sweeney, T.P., COL, DC				PRINCIPAL INVESTIGATOR (Furnish SSAN if U.S. Academic Institution)			
TELEPHONE: 202-576-3484				NAME <sup>a</sup> Peters, D., COL, DC			
				TELEPHONE: 301-677-6053			
				SOCIAL SECURITY ACCOUNT NUMBER:			
22. GENERAL USE				ASSOCIATE INVESTIGATORS			
Foreign Intelligence Considered				NAME: Tsaknis, P., COL, DC			
				NAME:			
23. KEYWORDS (Precede EACH with Security Classification Code) (U) Gutta Percha (U) Root-Canal Filling (U) Carbon Dioxide Snow (U) Thermal Pulp Testing (U) Endodontic Irrigation							
23. TECHNICAL OBJECTIVE <sup>a</sup> , 24. APPROACH, 25. PROGRESS (Furnish individual paragraphs identified by number. Precede text of each with Security Classification Code.)							
<p>23. (U) Army endodontic procedures in the military total 108,000 per year and are 25% of dental emergency procedures. Tooth reimplantation with endodontic therapy is involved in most serious facial injuries and involved typically 3 to 5 patient visits. The military can gain at least 50% reduction in patient and specialist man-hours spent in endodontic therapy with the development of more rapid and reliable treatment materials and techniques.</p> <p>24. (U) Two areas to be investigated under this project are: (1) Analysis of endodontic materials including those in use and newly developed; (2) techniques used in endodontic therapy with emphasis on the development of the most rapid and accurate method within the military type practice.</p> <p>25. (U) (79 10 - 80 10) A number of gutta percha filling techniques were evaluated with respect to canal contour replication and microleakage. Vertical and compaction condensation were found superior to lateral condensations as was the "chloroform-dip" method. All methods were equally effective in sealing ability. IRM was found superior to Cavit as a temporary endodontic filling. An evaluation of 7 different endodontic irrigation solutions did not reveal any significant difference in their cleansing abilities. The CO<sub>2</sub> "pencil" was found to be the current method of choice for determining pulp vitality. An improved in vitro method for evaluating cold transference during thermal pulp testing was developed and used in evaluating pulp cavity temperatures beneath amalgam and composite restorations with and without various cavity liners.</p>							

<sup>a</sup> Available to contractors upon originator's approval.

DD FORM 1498  
1 MAR 68

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MILITARY RELEVANT CYCLES  
SECTION 204 (FY FUNDS)  
BY *[Signature]*

PROJECT NUMBER 3S162775A825

DEVELOPMENT OF ENDODONTIC PROCEDURES FOR MILITARY DENTISTRY

Marginal Sealing Quality of IRM and Cavit as Assessed  
by Microbial Penetration

Since endodontic therapy often requires multiple treatment appointments, a temporary filling material is required to seal the access preparation between visits to prevent contamination of the root canal with fluids, organic material, and bacteria from the oral cavity. Bacterial contamination of the root canal has been associated with endodontic failure by leading to a breakdown of the associated periodontal supporting structures.

Two of the most frequently used temporary materials are a polymer-reinforced zinc oxide-eugenol intermediate restorative material (IRM) and Cavit, a premixed noneugenol paste containing zinc oxide, calcium sulfate, zinc sulfate, glycol acetate, polyvinyl acetate, polyvinyl chloride acetate, tri-ethanolamine, and red pigment.

The ability of *Proteus vulgaris* to penetrate the seal provided by IRM and Cavit was investigated by using an *in vitro* model system consisting of extracted molar teeth embedded in acrylic. All temporaries were allowed to set for 24 hours next to a cotton pellet containing camphorated monochlorophenol (CMCP) or saline. IRM which had set next to CMCP provided a significantly better seal after 3 weeks than IRM which had set next to saline, or Cavit which had set next to CMCP. Cavit placed next to saline was the least effective seal. IRM appears to be a significantly better temporary restoration than Cavit.

---

Comparison of Gutta Percha Filling Techniques.  
Part 1: Compaction (Mechanical), Vertical (Warm),  
and Lateral Condensation Techniques.

An *in vitro* technique was developed to evaluate the ability of various filling techniques to fill an artificial standard canal system. No significant difference was noted in volume changes over a two-week period between lateral condensation, vertical (warm) condensation or compaction (mechanical) condensation. The ability of the techniques to replicate the canal was statistically analyzed. It was found that the compaction technique was significantly better than the lateral technique ( $p < 0.01$ ), and the vertical technique was significantly better than compaction technique ( $p < 0.001$ ). The compaction technique was significantly the fastest. If speed is of primary concern, then the compaction technique is recommended. If accuracy is of primary concern, then vertical condensation is recommended.

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Comparison of Gutta Percha Filling Techniques.  
Part 2: Three Chloroform-Gutta Percha Filling  
Techniques.

An artificial standard root canal system was used to evaluate the effectiveness of gutta percha filling techniques. No significant difference was noted in the abilities of chloropercha, Kloroperka, and chloroform-dip to replicate the canal system. All three chloroform techniques replicated the system significantly better than lateral condensation.

In volumetric evaluation, the chloropercha fills decreased in volume 12.42% in 2 weeks while Kloroperka decreased only 4.86% and chloroform dip only 1.40%.

It is recommended if a chloroform technique is to be used, the chloroform-dip should be of significant advantage.

---

#### Comparison of the Effects of Various Irrigating Solutions on Dentine Permeability.

This study evaluated the penetrating and cleansing effect of seven different irrigation solutions or combinations of solutions used during endodontic instrumentation. Fifty-six extracted teeth were divided into seven groups and irrigated with the various solutions. The teeth were then filled with a warm radioactive  $^{125}\text{I}$  gel. The percentage of reduction of radioactivity caused by continued saline irrigation, drying and reinstrumentation was determined for each group. Further irrigation and drying versus additional instrumentation with larger instruments was also evaluated. A statistical analysis was made of the reductions in radioactivity obtained relative to the irrigating solution used. The original irrigation solution used did not appear to be a clinically significant factor.

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#### Evaluation of a New Thermoplastic Gutta Percha Obturation Technique Using $^{45}\text{Ca}$

Using the radioisotope  $^{45}\text{Ca}$ , this study evaluated the leakage following *in vitro* obturation of 60 root canals using three gutta percha techniques: lateral condensation, warm (vertical condensation, and the new mechanical compaction (McSpadden) technique. The techniques were used with and without sealer. No statistically significant difference was seen between techniques. The presence or absence of sealer did not alter the results. The new technique did not appear of significant additional value with respect to reducing leakage.

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*In Vitro* Effects of Ice, Skin Refrigerant, and  
CO<sub>2</sub> Snow on Intra-Pulpal Temperature

A reliable and yet practical pulp vitality test is essential in the evaluation of the pulpal status of teeth. The three popular tests today are thermal, electrical, and test cavities. Test cavities are the least desirable for obvious reasons.

A vitality test exists which has been popular in many parts of the world but which is largely untried in the United States. It is a cold test utilizing liquid CO<sub>2</sub> delivered through a "pencil". A pinpoint area of compacted snow results on the tooth. It is referred to as the CO<sub>2</sub> snow method to alternatively as carbon dioxide snow.

Three cold tests - ice, skin refrigerant, and CO<sub>2</sub> snow (CO<sub>2</sub> pencil) - were compared for their ability to decrease intrapulpal temperatures *in vitro*. A 5-second CO<sub>2</sub> snow application resulted in a statistically greater decrease than ice or skin refrigerant in both virgin and in crowned teeth. Although the amount and duration of temperature change a pulp can withstand is not known, the maximum 4 to 8°F. decrease produced by the CO<sub>2</sub> snow with return to normal temperature within a few minutes at most, did not seem extreme. Temperature transfer between teeth in proximal contact was shown to be relatively insignificant. The data plus clinical experience all indicate that the CO<sub>2</sub> pencil is the current method of choice.

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An *In Vitro* Method for Evaluating Intrapulpal  
Temperature Changes Caused by Thermal Pulp  
Vitality Testing

In order to more accurately determine the effect of various dental materials on cold transference to the pulp when using the CO<sub>2</sub>-snow, technique for evaluating

pulp vitality, a modification of an available *in vitro* testing technique was developed. Studies have indicated that the CO<sub>2</sub> snow method of evaluating pulp vitality is the most reliable among available methods. However, intrapulpal temperature changes produced during testing are significant and the modifying effects that various dental materials placed in teeth may have on pulp temperature when the vitality of such teeth are determined by CO<sub>2</sub>-snow is unknown. The modifications incorporated into the *in vitro* method for evaluating pulp temperatures include maintaining the test teeth at body temperature before and after testing and the ability to position the temperature probe more precisely in the pulpal area where the maximal cold transference will occur during vitality evaluation.

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#### *In Vitro* Cold Transference of Bases and Restorations

Using the *in vitro* system described above for evaluating pulp temperature changes, one-second applications of extreme cold (carbon dioxide snow) were made to amalgam and composite restorations in teeth with and without bases. Temperature changes were recorded intra-pulpally.

All bases under restorations reduced the intra-pulpal heat loss caused by external cold to a significant degree ( $p < 0.01$ ). The degree of reduction was much greater under the amalgam restorations, with all bases over 0.5 mm thick reducing the intra-pulpal heat loss to less than one-half that lost if no base is present.

By far the greatest protection against temperature change caused by short-term episodes of cold occurred with the first 0.5-0.6 mm of base. Under amalgam restorations, increasing an IRM base one extra millimeter only produced one-tenth



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---

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By far the greatest protection against temperature change caused by short-term episodes of cold occurred with the first 0.5-0.6 mm of base. Under amalgam restorations, increasing an IRM base one extra millimeter only produced one-tenth

the reduction caused by the first 0.62 mm of IRM. It is recommended that following very deep restoration, a temporary restoration be placed to give the acute inflammatory response of the pulp a chance to resolve.

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Publications:

1. Liggett, W.R., Brady, J.M., Tsaknis, P.J., and Del Rio, C.E. Light Microscopy, Scanning Electron Microscopy, and Microprobe Analysis of Bone Response to Zinc and Nonzinc Amalgam Implants. Oral Surg, Oral Med, Oral Path 49(3): 254-262, March 1980.
2. Drobotij, E., Grower, M.F., Bernier, W.E., Peters, D.D., and Lorton, L. Comparison of the Flushing Effectiveness of Four Different Types of Needles after Root-Canal Preparation. J. Endodont (in press).
3. Keller, D.L., Peters, D.D., Setterstrom, J., and Bernier, W.E. Microleakage of Softened Temporary Restorations as Determined by Microorganism Penetration. Accepted for publication in the J. Endodont.
4. Blaney, T.D., Peters, D.D., Setterstrom, J., and Bernier, W.E. Marginal Sealing Quality of IRM and Cavit as Assessed by Microbial Penetration. Accepted for publication in J. Endodont.
5. Augsburger, R.A., and Peters, D.D. *In vitro* Effects of Ice, Skin Refrigerant, and CO<sub>2</sub> Snow on Intra-Pulpal Temperature. Accepted for publication J. Endodont.
6. Peters, D.D., and Augsburger, R.A. *In vitro* Cold Transference of Bases and Restorations. Accepted for publication in J. Endodont.

RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY				1. AGENCY ACCESSION	2. DATE OF SUMMARY	REPORT CONTROL SYMBOL	
				DA OK 6020	80 10 01	DD-DR&E(AR)636	
3. DATE PREV SUMRY	4. KIND OF SUMMARY	5. SUMMARY SCTY	6. WORK SECURITY	7. REGRADING	8A. DISSEM INSTR	8B. SPECIFIC DATA - CONTRACTOR ACCESS	9. LEVEL OF SUM
79 10 01	D. Change	U	U	NA	NL	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	A. WORK UNIT
10. NO./CODES	PROGRAM ELEMENT	PROJECT NUMBER	TASK AREA NUMBER	WORK UNIT NUMBER			
11. PRIMARY	62775A	3S162775A825	AA	008			
<del>62775A</del>	<del>62775A</del>	<del>3S162775A825</del>	<del>00</del>				
<del>62775A</del>	STOG 80-7.2.5						
11. TITLE (Precede with Security Classification Code) (U) Biodegradable Materials For The Treatment of Fractures and Soft Tissue Wounds in The Military Situation							
12. SCIENTIFIC AND TECHNOLOGICAL AREAS							
01290 Physiology 010300 Miscellaneous Materials							
13. START DATE		14. ESTIMATED COMPLETION DATE		15. FUNDING AGENCY		16. PERFORMANCE METHOD	
68 01		CONT		DA		C. IN-HOUSE	
17. CONTRACT/GRANT				18. RESOURCES ESTIMATE		19. PROFESSIONAL MAN YRS	
A. DATES/EFFECTIVE:				PRECEDING		FUND (\$ in thousands)	
B. NUMBER:				FISCAL YEAR		63	
C. TYPE: NA				80		1.0	
D. KIND OF AWARD:				81		2.0	
E. CUM. AMT.				68			
19. RESPONSIBLE DOD ORGANIZATION				20. PERFORMING ORGANIZATION			
NAME: US Army Institute of Dental Research				NAME: US Army Institute of Dental Research			
ADDRESS: Washington, DC 20012				Division of Pathology			
				ADDRESS: Washington, DC 20012			
RESPONSIBLE INDIVIDUAL				PRINCIPAL INVESTIGATOR (Furnish SSAN if U.S. Academic Institution)			
NAME: Sweeney, T.P., COL, DC				NAME: Tortorelli, A., COL, DC			
TELEPHONE: 202-576-3484				TELEPHONE: 202-576-3778			
21. GENERAL USE				SOCIAL SECURITY ACCOUNT NUMBER:			
Foreign Intelligence Considered				ASSOCIATE INVESTIGATORS			
				NAME: Cutright, D.E., COL, DC			
				NAME: Grower, M., LTC, DC/Russell, E.A., COL, DC			
22. KEYWORDS (Precede EACH with Security Classification Code) (U) Esophageal Graft (U) Tracheal Graft (U) Biodegradable PLA-PGA (U) Polylactic Acid (U) Polyglycolic Acid (U) Tricalcium Phosphate							
23. TECHNICAL OBJECTIVE, 24. APPROACH, 25. PROGRESS (Furnish individual paragraphs identified by number. Precede text of each with Security Classification Code.)							
23. (U) To develop rapid and improved methods of treating combat injuries of the head and neck in the field using biodegradable materials. To develop premedicated biodegradable tissue fixation devices.							
24. (U) Biodegradable polylactic acid, polyglycolic acid and various combinations of these polymers as well as other polymers being developed will be applied in the development of surgical procedures for a variety of hard tissue, soft tissue and hollow organ injuries in animals and extended to man where appropriate.							
25. (U) (79 10 - 80 10) Two animals (dogs) with PLA-PGA biodegradable segmental esophageal grafts have survived 16 and 22 months. The animals are on regular diets and no dilation of the esophagi has been required. Attempts to evaluate the condition of the grafts <u>in vivo</u> are in progress. A prosthetic device for the segmental replacement of the trachea in dogs was constructed from biodegradable PLA-PGA polymer and tricalcium phosphate ceramic rings. The devices were placed in 3 dogs. At 5 weeks post-surgery the devices failed. Cause of the failures were determined and redesign of the prosthesis is in progress.							
MILITARY RELEVANCY CERTIFIED UNDER SECTION 204 (EY FUNDS) BY <i>Burnard. C. D. H. H. H.</i>							

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PROJECT NUMBER 3S162775A825

BIODEGRADABLE MATERIALS FOR THE TREATMENT OF FRACTURES AND  
SOFT TISSUE WOUNDS IN THE MILITARY COMBAT SITUATION

Evaluation of a Biodegradable Graft for  
Reconstruction of the Esophagus in Dogs

Two animals (mongrel dogs) survived into the current fiscal year and are now 22 and 16 months post-operative insertion of an esophageal graft. The esophagi of both animals remain adequately patent to support a regular diet. Dilation of the esophagi under anesthesia has not been required for the past 12 months.

Attempts were made to measure and record contractions of the esophageal wall electromyographically in one dog in which the graft had been in place for 13 months. No contractions were observed or recorded either under regular or light anesthesia. A normal dog was studied with similar failure to measure esophageal contractions following swallowing. It was surmised that the dog was an unsuitable model for this type of study.

Barium swallow studies were done using static x-rays. Due to the lack of dynamic visualization techniques, no definite information could be obtained.

It was decided to keep the animals alive and attempt fluoroscopic studies with barium and simultaneous video taping when equipment becomes available.

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Evaluation of a Prosthesis of Biodegradable and Biocompatible  
Material for Reconstruction of the Trachea in Dogs

Three dogs were operated on in FY 1980 with the replacement of a 4 centimeter segment of the cervical trachea in each dog. All three dogs either died or had to be euthanized at 5 weeks  $\pm$  2 days post-surgery because of severe

respiratory difficulty, cyanosis and pleural effusion. Gross examination of the tracheal specimens from all three animals indicated that with resorption of the polymer between the ceramic rings in the prostheses, the rings pulled or collapsed toward one another and, acting as a single unsecured ring in a tube, rotated anteroposteriorly and progressively blocked off the tracheal lumen.

Histologic sections in all three specimens revealed prolific and fairly complete replacement of the biodegradable polymer portion of the prosthesis by connective tissue which was quite cellular. No epithelial elements were present on the luminal wall of the prostheses.

Scanning electron microscope studies of the ceramic rings showed them to be quite dense without any porosities as were thought to exist when implanted. Subsequent discussion with the contractor indicated that there was no requirement that the rings be porous and, in fact, were not porous at all.

It is felt that auxilliary struts are needed to mechanically separate each of the rings imbedded within the polymer of the prosthesis. For reasons of simplification, Teflon will be substituted for the ceramic in future prostheses. These Teflon rings will be cut from a tube of Teflon giving the appearance of a tubular mesh with struts at 120, 240, and 360 degrees separating each ring. These new prostheses are being made presently and will be implanted in FY 1981.

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PUBLICATIONS FY 80

US ARMY INSTITUTE OF DENTAL RESEARCH (USAIDR)

1. Huget, E.F., Vermilyea, S.G., and Vilca, J.M. Studies on White Crown and Bridge Alloys. *Milit Med* 144(12):810-909, 1979.
2. Vermilyea, S.G., Modawar, F.A., and Huget, E.F. Laboratory Evaluation of Crown and Bridge Temporary Resins. *Milit Med* 145(5):343-344, 1980.
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10. Lamb, L., Hawley, C.E., and Kakari, S. Effect of Fetal Calf Serum on the Production of Osteoclast Activating Factor in Mixed Leukocyte Culture. *J Dent Rsch* 59(A):333 (264), 1980.
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13. Regeneration of Surgically Excised Segments of Dog Esophagus Using Biodegradable PLA Hollow Organ Grafts. D.E. Cutright and E.A. Russell. Program of the 1980 Army Science Conference. Office of the Deputy Chief of Staff for Research Developments and Acquisition. 17-20 June 1980, p. 34.
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18. Lorton, L., Moore, B.K., Swartz, M.L., and Phillips, R.W. Rheology of Luting Cements. *J Dent Rsch* 59(9):1486-1492, 1980.
19. Outright, D.E., Huget, E.F., and Brady, J.M. Asbestos: A Subtle Carcinogen in the Dental Laboratory. *General Dent* 28:46, 1980.



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